Including Ham Radio Fun!

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73 Amateur Radio Today

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160m Table Top Loop

Great Grandchild Gizmo

Antenna Design for Klutzes

Ildi HAØUZ

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EMTECH QRP X

THE TEAM

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NOVEMBER 1997
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73® Amateur Radio Today

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TABLE OF CONTENTS

FEATURES

REVIEW

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: XYL Ildi Bogyo HAØUZ shares this shack with OM Steve HAØDU in Debrecen, Hungary. Photo by George Pataki WB2AQC. Send us your possible cover shot photos, gladly returned if not purchased.

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NEVER SAY DIE

Wayne Green W2NSD/1

The End Is Near!

The end of the year, that is. You're probably reading this in October, Halloween month. The cover is dated November, which means Thanksgiving is coming soon. And that means just one more month until Christmas. And a week after that is New Year's Day, when you're supposed to make all those resolutions. You know, the promises to better yourself that you aren't going to keep.

Alas, we all seem to work on the same system as our big corporations, thinking at most about a quarter of a year ahead. If we had any interest at all in the long range, we'd immediately change our diets, get the mercury out of our mouths, the lead out of our pants, and so on. All that stuff I've been preaching. All that stuff you've been snoring through.

Sure, our ham radio contests are fun. At least for a few of us. For the rest they can be a royal pain. For the very few they're *important*. They buy their stations around winning contests. But then there are a few severely misguided souls who think that working DX is *important*. Making momentary contacts with hams in rare countries for the sole purpose of getting a QSL card doesn't hold up for me as *important*. Hey, I've been there, done that. I recently ran across a big carton of my old QSL cards out in the barn. Sure, working some of the rare ones was fun, and I once used my cards from around 350 countries to dress up a book I wrote on how to work DX. And when I get my Silent Key Award from the ARRL my cards will go in the trash, along with all that other ham junk in the barn.

With the new sun spot cycle starting, and with the end of the world coming due in one, two or 10 years, depending on which Art Bell Show doom-meister you believe, can I sell you on trying something new this winter? It could be your last chance!

For instance, how about trying your hand at some ham satellite contacts? Then write me a letter and tell me how you went about it and how much fun you've been having.

Say, have you ever tried making aurora contacts on two meters? I've got it on good authority that there have been several darned good auroras this summer with no one in there making contacts. No one! Yes, you do have to either know the code at around 5 wpm, which is about as fast as code can be sent via the aurora, or use sideband. Try it and write to me. A CW signal comes through as pulses of white noise and sideband sounds like someone whispering.

If that's too exciting for you, how about getting on six meters and letting me know what you've worked? I hear we've been getting some interesting openings into South America.

Have you ever mountaintopped? I've had some great adventures operating from the top of Mt. Greylock in Massachusetts, Mt. Mansfield in Vermont, Mt. Washington in New Hampshire, and Cadillac Mountain in Maine. Do it and let me know how you make out. Send some photos too. Heck, I remember when a New Jersey club would make weekend mountaintop expeditions and rack up hundreds of contacts. It was a one-club contest.

If you are inactive, make a Halloween resolution to get on some new band by Thanksgiving. All it takes is a dipole to get started. And let me know what you find. Is it fun? Or boring?

Can I get you to start bringing up interesting subjects to talk about on the air? What I've been hearing on 20 meters lately sure hasn't encouraged me to put up a better antenna. It isn't like I haven't been providing you with stuff in my editorials. And if you tape the Art Bell Show every night you'll have still more ammunition. And if we do hook up on 20, please don't tell me what rig you've bought, or about your antenna—unless I specifically ask (which I guarantee I won't).

If the doomsayers are right, you don't want to spend your last hamming days swapping QSL information, and 73, thanks for the contact, do you? Oh, you do? Okay, never mind.

Take the Express!

Why take the local through life, stopping at every stop and taking forever to get there? Yes, there *is* an express! There's a fast track to health and wealth—to success. The good part of the fast track is that few people know about it, so you'll have very little competition. The bad part is that not only don't other people not know about it, they don't even believe it's there. They totally believe that the slow track is all there is—the track that takes you through four or five years of college and a lifetime of working for someone else.

If you haven't heard the cliché that "you'll never get rich working for someone else," it's high time you not only hear it, but give it some very serious thought. When you work for yourself not only can't you be fired, downsized, or outsourced, you are the one setting your own salary. And there's no one to ask you whether you have a degree in anything or not.

Sure, there are a bunch of self-employed people who are never going to make much money. Working for yourself isn't a total answer, you also want to be picky about what kind of work you're going to do, making sure that it has the potential for both making a lot of money and for providing you with some freedom to enjoy it. I'm talking about some sort of entrepreneurial enterprise other than running a grocery store or restaurant.

How do you find the product or service which is going to put you on the fast track? And how do you build all of the skills you'll need to run your business successfully? By going to college? None that I've found yet! And not for a lack of looking. The fact is that colleges don't want you to know how much of a waste of your life a college degree is when it comes to being an entrepreneur, so they're not about to teach such dangerous ideas.

No, if you want to take the express you'll want to start early and learn what you need to know with someone else paying the bills. Learn on Other People's Money (OPM). That's why I recommend starting as early as you can as an apprentice (a.k.a. trainee) with a small entrepreneurial company in a field that's more fun than work for you, making it your business to learn everything you can about the business.

I've lectured on this at Yale, Rensselaer Polytechnic Institute, Case-Western University, Babson College, Boston University, and a bunch of other colleges, but for some reason they don't ask me back. Oh, the kids love my talks—it's the professors who aren't enthusiastic about 'em. Hey, let me know if you ever find a college professor who has given up a successful life as an entrepreneur to teach.

Medical Science?

Medical "science," like all the other so-called sciences, has a long and almost unbroken history of rejecting new ideas. You've probably read about Semmelweis, who was ostracized by his colleagues and fired from the hospital for recommending that doctors wash their hands before assisting in births. And then there was Pasteur and his stupid germ theory.

But I'll bet you haven't heard about Laennec, a young Frenchman who invented the stethoscope. His colleagues ridiculed him and suggested that it was the work of the Devil. He used a

rolled-up paper cone, which left a red ring. Witchcraft!

Alas, 150 years later little has changed. Doctors are still resisting new ideas, so is it any wonder that medical "science" is still fighting cancer with surgery, radiation, and chemotherapy (poisons), despite abundant evidence that *all* cancers are caused by our diets?

How many women would give up eating chocolate if they knew the connection between chocolate and breast cancer?

Since your present diet is around 99% guaranteed to give you cancer or a heart attack, nothing I can write is going to change you. Dr. Schweitzer never saw a case of cancer among the African natives until the white man's diet was introduced. Dr. Stephenson found the same among the Eskimos. Hey, I'm thirsty—pass me a cold Coke®.

When people get sick they want something done, and quickly. Prompt relief is what they want. Very few people want, or are interested in, a cure. What they want is relief from bothersome symptoms, and at any price. So doctors continue to practice palliative medicine, which seldom produces a cure. They get rich and we get sick and die 20-30 years before we need to. Well, it's good for Social Security, the insurance industry, the HMOs, hospitals, AMA, FDA, NIH, WHO, the National Cancer Institute, General Foods, General Mills, and on down the line. The only downside is us, and we don't seem to care one way or the other.

Smoking

Despite the best efforts of the tobacco industry, their thousands of lobbyists, and flocks of scientists paid to see no evil and suppress the facts, we are seeing more and more evidence of the massive cover-up conspiracy between them, our government, the medical industry and the insurance companies.

We now know that nicotine produces temporary stimulation at first, but fatigue, depression, nervousness, diminished reflexes, impaired reasoning capacity and loss of memory follow after a few years. We also know that it's one of the most addictive substances yet found.

But we're slowly making headway. If you watch the old movies you'll see all of the stars smoking cigarettes. In today's movies, when someone lights up you know right away that this is a bad guy. Remember *Waterworld*, with the bad guys being the "Smokers?" And the very worst villain on the *X-Files* is the Smoking Man.

When I see kids smoking these days I know (a) they are stupid, and (b) their parents are not much interested in them.

Yes, it's an extremely difficult addiction to kick, but the fact is that millions have succeeded in stopping so, unless people's motivation and determination have been gutted by our school system, anyone *can* stop.

Music Soothes

In addition to the usual poisons you've been putting into your body, plus your pathetically lousy nutrition, another killer is stress. Yes, old Doc Green is going to prescribe music as one of the better ways to reduce stress. And I don't mean rap or rock, either. I'm talking about classical music, and it doesn't get much more soothing than some of that. Just wait'll you get a load of some of the incredible music Delius wrote! And Gottschalk!

The fact is that every disease we come down with has a psychological component, so if you can get rid of that trigger, your body will usually be able to surmount the immediate infection. As Béchamp, Rife, Naessens and others have discovered, it's more a weakness of the body that brings on illness than an infection from outside.

Back when I was publishing the country's leading music magazine I found that the startlingly superb sound of compact discs had substantially increased the public's interest in classical music. The problem was that there were tens of thousands of classical CDs available and the newcomers didn't know which were best to buy. So I sat down and put together a recommended 100 CD classical music library—of music that time and millions of music lovers have proven to be the very best of the classics.

I originally wrote it as a series of five articles for *CD Review*, but I've now put the five together into a 20-page booklet.

What are the cream of the cream of symphonies, overtures to operas, ballet music, tone poems, concertos, dances, marches, and piano music? You'll find my guide to your stress reduction helpful in sorting out the wheat from the chaff. And even Beethoven wrote a bunch of chaff. Ditto Mozart.

If you don't know Zoltan Kodaly from Ketelby or Kabalevski, just let kindly old Doc Green sort it out for you. Send for my $5 Guide to Classical Music and start getting your mind into some kind of shape. I prescribe at least 30 minutes a day of brisk walking, and another 30 of stress reduction with the classics.

Educating Our Own Children

With the day of the prenuclear family long gone, with fewer and fewer families being able to get by with only one breadwinner, how can we give our kids a decent break in education? With most jobs these days requiring parents to be away from home for at least eight to nine hours—most of the waking hours for younger children—even if parents knew what best to teach their children, they're not around to do it. This is a situation parents have to recognize and come to grips with.

As I've pointed out, by far the most critical years for children are the earliest. This is when the patterns of a lifetime are established. Firmly established. No amount of remedial work later on is ever going to completely erase a mindset that is developed in these first few years. This is when the exposure to mind-expanding experiences help their brains to build the neural circuits which will allow them to cope with language, reading, and other such critical skills. Once this window of opportunity has passed, it's closed forever.

Thus you can see how millions of children are being permanently hobbled mentally (brain damaged, if you will) by the lack of good early education. Working parents find a nearby day-care center and park their babies for nine or 10 hours a day. With few exceptions, day-care centers tend to be just that and little more. They keep the babies and young children in their care fed and dry and as quiet as they can. How many parents have ever spent a whole day at their children's center to see what goes on? One in a hundred? One in a thousand?

Babies need personal attention. They need love. They need someone to read to them. They need to be held. They need toys to attract their attention and involve them. They need to be encouraged and congratulated when they try something new. They need to experience what success feels like. They need to learn how to be adventurous. They need to understand that failure is all part of eventually winning and not to be feared. They need to understand that they are different and that this is good. They need to find out that they can do almost anything they believe they can.

Yes, this is a lot to expect from a day-care center. But no day-care should provide any less! This is why I've recommended that we enlist the help of retired people, of the elderly from nursing homes, and that mothers start job-sharing so that one can help with day-care in the mornings and the other afternoons. These families will have one and a half pay checks instead of two, but they'll know that their children are getting the best possible start in their lives.

With day-care like this I believe we'll be headed toward a country with fewer poor, much less crime, less drug problems, and with more highly motivated kids, eager to get all they can from our educational system.

Have you noticed that whenever we can't pay attention to something it seems to fall apart? Well that certainly holds for educating our babies—and our children. We haven't been paying attention. For some reason we seem to feel that even though our government has failed us in almost every other way, at least as far as education is concerned we can depend on it. Well, it's doing education as poorly as it's handling our banks, the deficit, and almost everything else we see exposed in the news.

Your children are going to get a good education when you pay some attention to them and start trying to change the system which our collective neglect has allowed to strangle our country. It's our educational system which is at the bottom of virtually all of our problems. It's been making the poor poorer. It's been decimating our cities. It's been encouraging more and more jobs to be exported.

If our babies had been properly educated we wouldn't have

Continued on page 8

QRX . . .

Amateur Radio Needs Dramatic Rethinking

It is tempting to conclude that threats to amateur radio come from spectrum auctions alone. But the problem is more complex than that. What if nobody wants to become an amateur radio operator? What if our "product" is wrong and there are no buyers? No amount of fiddling with our marketing—or license structure—will sell the product if we have the wrong product to sell in a world awash with interesting and competing technologies.

From a public relations perspective, should the amateur service even be called that? The word "amateur" has negative connotations ranging from inexperienced, cheap, low quality, unreliable, to worse.

Amateur radio has changed little in 30 to 40 years. Today's amateur radio service relies on technology that is "old" and not spectrum-efficient. FM is 50 years old; SSB is 40 years old; CW is over 100 years old and 1200 bps AX.25 packet is based on the 15-year-old obsolete "dumb terminal" rather than personal-computer-based networking. Yes, these technologies still work—but how do we advance from here? Regulatory structures and our "voluntary" band plans stifle innovation and institutionalize the status quo. The result: We are growing stale as the world rushes by.

Not long ago in the US, regulations prohibited use of the popular ASCII code for computer data.

Current regulations place burdens on spread-spectrum (SS) systems—techniques that are now state-of-the-art in unlicensed wireless systems and some cellular phone networks (our homes' cordless phones use direct sequence spread-spectrum). FCC 97.311 requires that you "Maintain a record, convertible to the original information (voice, text, image, etc.) of all spread-spectrum communications transmitted" for *a full year.* You cannot realistically use SS technology for routine amateur communications unless you are prepared to maintain a copy of every transmission you ever made. By law, we are prevented from adopting state-of-the-art technology for routine amateur communications.

Paradoxically, you can operate an unlicensed SS transmitter at a one-watt power level in the amateur bands at 902, 2400 and 5725 MHz, and do anything you want—but not as an amateur station! Part 15 SS devices sharing the amateur bands can do anything they want. Does this make sense to you?

In 1996, the Tucson Amateur Packet Radio group had to fight hard for a special temporary authority to operate direct sequence spread-spectrum communication technology in the amateur bands. While the ARRL said it supports TAPR's efforts, it then opposed most of the details in the TAPR proposal.

Legally, you can transmit digital data using data compression—but you must "maintain a record, convertible to the original information, of all digital communications transmitted" *forever.* Does this make sense?

Part 97 effectively prohibits amateurs from adopting modern digital communications. Yes, you can experiment, but forget about widespread adoption of your inventions.

The Part 97 rules contain outdated notions of amateur emergency communications. Strangely, the "RACES" rules limit amateurs to a maximum of one hour per week of participating in RACES training (except that twice per year you can apply to the government for special exemption to this rule). When your government runs a mass casualty drill that lasts a full day, you can hardly walk off the job an hour after arriving. The RACES rules are oriented towards an historical amateur service consisting of large, fixed-location, point-to-point HF operations—yet most RACES operations take place at VHF and above.

Only recently was FCC 97.113 written to clarify the legality of calling a tow truck for a motorist whose vehicle is disabled on the side of the road. Poorly thought out rules led to situations where amateurs questioned whether it was okay for hams to provide emergency communications support for disasters—wasn't this just helping a fire department in its *routine business* operations, and aren't business communications prohibited? Sigh.

By Ed Mitchell KF7VY, found in the *Brandon Amateur Radio Society Newsletter*, May 1997 issue. They reprinted it with permission from *Ham Radio Online* magazine, available for free on the Internet at [http://www.hamradio-online.com].

The Doctor is Destinated: Questions & Answers for the New Ham

Q. A repeater expert told me that my signal would hit him better if I was horizontally polarized. Now when I go for my walks I tilt my head sideways to talk into my HT. This makes me dizzy. Do you have any suggestions?

A. Actually, you can never really determine at what angle your modulations will hit the repeater. Circular polarization is probably the most reliable. To achieve this, the Doctor suggests that when you go for your walks you hold your head straight up, but you should walk in little circles.

Q. When I listen on the repeater, I often hear guys saying strange things that start with Q, like Q Artie, and QS Why, and QS Elle, etc. What do these things mean?

A. In the old days of radio, before hams were invented and they had to do it with flags, they had special three-letter codes called Q-signals, which had specific meanings. Fortunately, it is now the '90s, and we live in America where we have freedom. Just as you no longer need to actually learn anything to get your ham license, you can use Q-signals to mean anything you want. So if they use ones you don't understand you will just have to ask them—preferably using a Q-signal such as QQQ?—meaning "Huh?"

Q. I live in California and my wife just got transferred to Illinois for her job. We are both hams. I am a Tech plus and she is only a Tech. What is the best way for us to communicate—should we use the 2-meter, or satellite, or what?

A. Actually, neither. The Doctor suggests that you look through her stuff and see if anything has her new address on it and a big number, at least 10 digits long. This is called a phone number. When you punch it into your phone, the phone will automatically seek out the best repeater for your comms.

Each month the Doctor will answer the most interesting questions from readers. Questions may be edited for length and clarity, which is why many of them disappear altogether.

Author anonymous, TNX *Low Down*, official journal of the Colorado QRP Club [cqc@aol.com].

Theft Deterrent System on Ham Bands?

The FCC has received a Petition for Rule Making from Checkpoint Systems, Inc. The company wants the Commission to permit electronic article surveillance operations in the 1.705 to 30 MHz band. This, at a fairly high maximum radiated emission level.

Checkpoint Systems is the manufacturer of some fairly sophisticated electronic article surveillance systems that use frequencies in the 1.7 MHz to 10 MHz range. It is regulated as an unlicensed intentional radiator under Subpart C of Part 15.

Under Part 15 rules, such devices may operate without restrictions on bandwidth, duty cycle, modulation technique, or application, but must comply with specified radiation and emission limits and protect licensed services from harmful interference. But Checkpoint says it needs the higher power levels to overcome what it calls the increasing levels of ambient RF noise in commercial establishments. The expanded frequency range, the company says, will allow for greater flexibility in deploying EAS systems and reduce the potential for false alarms.

Checkpoint already holds an experimental authorization to operate EAS equipment within the 7.4 MHz to 9 MHz and 8.2 MHz to 10 MHz bands at higher power levels. The company says it has received no complaints of interference. Its Petition for Rule Making was received by the FCC on April 28.

From FCC, ARRL, via *Harmonics*, newsletter of South Jersey Radio Association, June 1997.

CQC Top Ten Reasons for Running QRO (High Power)

10. I can tell all my neighbors about my ham radio activities by direct input to their TVs, radios, and telephones.

9. My tuner will handle a kW and it would be a waste of capacity not to use it.

8. Everyone in the world needs to know that I have more dollars than sense.

7. Why kill two birds with one stone when I can kill *all* the birds with one kW?

6. A kW or two gives me a real edge in those QRP contests.

5. Keeps those pesky QRP guys from getting too close to *my* frequency.

4. A signal report is meaningless unless it includes "dB over 9."

3. The linear keeps my coffee warm.

2. The lights flicker so I know I really am getting out.

And the number one Reason for Running QRO:

1. Two words: Sexual Insecurity.

From *Low Down*, official journal of the Colorado QRP Club (cqc@aol.com).

My Radio Ham

The wife of Charles Brown N5CB has written a poem which expresses, we're sure, the feelings of many of our XYLs—or should we call them Amateur Radio Widows? We can be sure it was written with love. It appeared in the April 1996 *CQ* and is shared with you by permission of N5CB.

My Radio Ham
By Doris (Betty) Brown

I'm married to a man who's a radio ham.
He messes up my TV and doesn't give a damn.
I get on the phone and nothing's clear,
He yells, "Betty, it ain't coming from here.
Something's happening in the atmosphere,
Hang up the phone for a while, my dear."
He says, "I'm trying to work this station and there's a mighty jam."
But you know how it is with a radio ham.
He used to have a job with Uncle Sam,
But he gave it all up to be a radio ham.
He's got a big mouth, boy can he shout,
I'm always glad to hear when it's "Over and out."
I get real mad and he knows I am.
Doesn't bother him, he's a radio ham.
He sits there listening with those things on his head,
If I didn't know him I'd think he was dead.
His code rings out loud and clear,
A sound that's music to another ham's ear.
He talks to Moscow and Amsterdam,
Let's everyone know he's a radio ham.
One day I'm gonna give him a big black eye,
Cause he ain't done a thing about this TVI.
I'm stuck with him and he's stuck with me,
Guess I'll never stop hearing "N5CB."

From Pelican Bay Amateur Radio Club's May 1997 *PBARC SPARKS*.

NJ Judge: Ham Interference Out of His Hands

A New Jersey Superior Court judge has ruled that federal law prevents him from declaring ham radio interference a nuisance. Judge Reginald Stanton made that determination in a case reported April 16 in the New Jersey *Star Ledger*, in which a couple sued their neighbor, Walter Kornienko K2WK, of Lafayette NJ, claiming his transmissions interfered with their telephone, TV, and garage door opener. The couple, Leopold and Karen Korins, was trying to get Stanton to declare the situation a nuisance and to direct Kornienko to cut back on his hobby. But Kornienko's lawyer claimed his client had a right to operate under a federal license and suggested the Korins do more to shield their appliances from RFI.

"There is no question that there has been meaningful intrusion into the Korins' home and their expectations of enjoying a reliable and reasonably high quality level of telephone and television reception," Stanton is quoted as saying in the *Star Ledger* report by Bill Riley.

Stanton conceded that the FCC had jurisdiction and he had no authority to limit Kornienko's hamming. "If he is obeying the FCC rules and the Korins can't fix the situation in their home, that's tough," Stanton reportedly said.

Reprinted from *ARRL Electronic Letter* in the May 1997 issue of *Harmonics*.

Isn't That Special?

The FCC will allow a licensee to substitute a self-selected callsign from the block of 1x1 callsigns for temporary use during a special event operation. The station must announce its regularly assigned callsign at least once an hour. The special event callsigns will be coordinated and issued by outside volunteer entities, not by the FCC.

The FCC has raised the eligibility requirement from at least two members to a minimum of four. Applicants for a club station license must have a club name, a document of organization, management, and a primary ham radio purpose that's consistent with FCC rules.

Responding to a petition by the National Conference of Volunteer-Examiner coordinators (NCVEC), the FCC said VECs could elect to designate a session manager if they wanted to, but they would not be required to do so.

Another change will allow hams to include a self-assigned indicator before, after, or both before and after the assigned callsign, when identifying. Current rules only permit using such indicators after the station's regular callsign. Self-assigned indicators include those used to indicate location or type of operation, such as /KP2 when operating in the US Virgin Islands or /m when operating in a vehicle. They also can denote participation in an unusual event or other atypical station operation, according to the FCC.

The FCC announced all of the rules changes in a Report and Order, FCC 97-99, adopted March 20 and issued April 1, 1997. The amendments become effective 30 days after the Report and Order is published in *The Federal Register*.

TNX to the May/June 1997 issue of the *Pine State ARC* newsletter for finding this in the *ARRL Letter*, Vol. 16, No. 14.

Darwin Award Winner Announced

For those of you who are not familiar with the Darwin Award, it's an annual "honor" given to the person who did the gene pool the biggest service by killing himself in the most extraordinarily stupid way.

The 1995 winner was the fellow who was killed by a vending machine which toppled over on top of him as he was attempting to tip a free soda out of it. In 1996 the winner was an Air Force sergeant who, feeling the need for speed, attached a JATO unit to his car, managed to get airborne—and crashed into a cliff several hundred feet above the roadbed. And now, the 1997 winner: Larry Waters of Los Angeles—one of the few Darwin winners to survive his award-winning accomplishment.

Larry, who always wanted to fly, decided one day that he would try it in his own back yard. He went to the local Army-Navy surplus store and purchased 45 weather balloons and several tanks of helium. Back home, Larry securely strapped the balloons to a more or less sturdy lawn chair. He anchored the chair to the bumper of his jeep and inflated the balloons with helium. Larry's plan was to lazily float up to a height of about 30 feet above his back yard after severing the anchor and in a few hours come back down. Satisfied that his "flying machine" would work, Larry packed several sandwiches and a six-pack of Miller Lite™, loaded his pellet gun—figuring he could pop a few balloons when it was time to descend—and went back to the floating lawn chair and tied himself in along with his pellet gun and provisions.

When he cut the cord anchoring the lawn chair to his jeep, he didn't float lazily up to 30 or so feet. Instead, he streaked into the LA sky as if shot from a cannon. After a thrilling climb, he finally leveled off at an altitude of 11,000 feet. At that height he couldn't risk shooting any of the balloons, lest he unbalance the load and really find himself in trouble. So he stayed there, drifting, cold and frightened, for more than 14 hours. As he drifted into the air space controlled by LAX approach control, a United Airlines pilot spotted Larry and radioed the tower that he had just passed a guy in a lawn chair with a gun. Radar confirmed the report.

As Larry slowly floated above LA and out over the Pacific, LAX launched a helicopter and sent it in hot pursuit. Once the helicopter crew determined that Larry was not dangerous, they attempted to close in for a rescue. Finally, ascending to a position several hundred feet above Larry, they lowered a rescue line. Larry snagged the line and was towed back to shore.

As soon as Larry was hauled to earth, he was arrested by waiting members of the Los Angeles Police Department for violating LAX restricted airspace.

TNX to Bill Moore of Melbourne FL, who forwarded this to *Harmonics*, newsletter of the South Jersey Radio Association (May 1997 issue), from which *we* appropriated it.

This Is Only a Drill

The ARRL wants the FCC to allow hams actively supporting emergency or disaster communications or involved in drills and tests to communicate "between and among" RACES stations and those stations registered with civil defense organizations operating under RACES. The League also wants the FCC to relax time limitations on RACES emergency drills and tests. This would permit stations operating under RACES to communicate as necessary, during emergencies, tests, and drills, with non-RACES stations also engaged in emergency communication or drills.

ARRL Letter, Vol. 16, No. 12; TNX Pine State ARC.

LETTERS

From the Ham Shack

Dan Lakenmacher N5UNU. You made some interesting observations in your editorial that discussed hamfests (among other things). You asked for ideas and comments from your readers.

Let's start with an idea that works at hamfests. Either get a table to sell gear or carry something to sell. By providing a conversation opener you will meet people who might otherwise have been too shy to talk with you. Don't walk down the center of the aisles glancing quickly from side to side. Inspect the merchandise. Don't be afraid that someone will sell you something that is not up to specs. That's life in the big city. Buy and sell. You will learn a lot. If you have a table I see nothing wrong with selling one or two items that are not directly ham related, though I personally abhor the sale of craft items or jewelry. You will benefit by offering a variety of gear and if you price an item fairly it will usually sell and you will have a great time and meet some new folks. You have to give a little to enjoy a hamfest.

Another idea. My wife often mans my table so I can run around, spend money and get new ideas. Linda AB5RI loves to meet and talk with people and they like to talk with her. She usually sells everything on the table and she gets to keep all the money. Why not? Linda has friends all over Texas, Oklahoma, Louisiana, and Montana that she met at hamfests. Linda doesn't talk about temperature, antenna type, name of rig, etc., but instead she talks about what the other person is interested in. Auntie Mame put it better than anyone when she said, "Life is a banquet, and most sonafabitches are starving to death."

Wayne, you asked for the name of a good speaker. I'll give you the name of a man who is always prepared, has great visual aids, combines enthusiasm and practicality with a true understanding of how brief our attention spans really are: Press Jones, The Wireman. I have never listened to Press without learning something that benefited me as a ham. I would especially recommend his demonstration of resonant antennas using a miniature transmitter and receiver and various antennas, etc. As in everything else, Press gives all the credit for this demonstration to someone else.

You aren't the only one who can ramble, Wayne. I've written two letters to you and you printed both. I'll bet you print this one, too.

You win ... Wayne.

Reed Reisner W7FXG. I read René's book and it completely changed my mind about NASA. René says that space is too hot for humans. I am 73 and have been poisoning myself all my life, thanks to our food marketing system. I am a retired electronics instructor. I was in the Merchant Marine as a radio man and have circumnavigated the globe, though I'm far short of your 132 countries visited.

On cold fusion, I believe in it. If I were 20 years younger, I'd start to learn a new discipline. On John Taylor Gatto, my wife and I taught school for the Los Angeles City School System and in Utah. We could write our own book on how rotten the system is and why we've lost our country. How about New Hampshire: Do the teachers there tell the truth about the Fed? I doubt it!

Of course not, but then I don't think any of them know the truth about the Fed. Very few people do ... Wayne.

Jim Maricle W7DQM. I have been a subscriber to *73* almost from its inception. I enjoy your editorials and look forward to reading same each month. In particular, I not only enjoyed, but find that I have had the same feelings about government's intrusion into every fiber of our existence as you describe in "Dim Bulb," Sept., page 47. Let it be known that your voice is not alone in the wilderness. Similar views can be found daily on Rush Limbaugh's radio broadcasts. There is a station on satellite TV that devotes its entire programming day to enlightenment of viewers as to what our government is doing to us to increase the bureaucracy. The station, NET, can be found on Satellite W-1 (GE-1, 103 degrees west, Channel 19). I personally am writing periodic E-mails to my congressman, Newt, Forbes, my senator, talk show hosts and, most importantly, to the editor of our newspaper. Please keep up the good work that you are doing by recognizing for your readers that regardless of party, every move our overblown government makes is political.

But can we take back our country from the politicians? ... Wayne.

William McConnell KD4UUB. I have just read KB9FO's article in the September issue of *73* ("Explorers, Adventurers, and Experts"). It is the most reasonable, logical and promising proposal I've read for reviving the amateur radio service. I would make just one suggestion. It is my observation that there are two categories of hams: "techies" and "talkies." "Talkies" are those who contribute most to amateur radio as communicators and operators. "Techies" are those who like to build their own gear and experiment with equipment and modes. My suggestion is that KB9FO add more "merit badges" for experimentation and home-brewing to his proposal. The ham community should get behind KB9FO's Petition for Rule Making and encourage the FCC to give it the serious attention it deserves.

NEVER SAY DIE

Continued from page 5

millions on welfare, millions more on unemployment, all watching sitcoms, ball games, game shows and soaps to pass the time as painlessly as possible until death them do part.

Yes, I know that every day at work is important, but if you had a death in the family, could you take off a day? Well, you *do* have a death in the family—it's your child's incremental death. So take off a day now and then and spend it with your baby at the child-care center and see for yourself what's going on. You may want to take another day off and see what's going on in another center, to see if it's better or worse. Then, after seeing what's going on, you may want to quit your job and open a more intelligently-run center yourself.

In many centers you're going to see babies and youngsters sedated with television. Hours and hours of TV. Sesame Street, Mr. Rogers, and cartoons. I've already explained why these programs are so disastrous for kids, despite their shelves of awards. If you want to find out more about all this I suggest you read *Endangered Minds* ($11) and *Your Child's Growing Mind* ($10) both by Dr. Healy. The first is from Simon & Schuster, the second from Doubleday. Get 'em, dammit!

If you got a call from the center saying your child was sick, could you spare the time to go help? Well, your child *is* sick—and needs your help. Your child is being permanently crippled, a little bit at a time. Of course you can wait it out and wonder why your child "went bad." What did you do as parents to rate this lazy, rock-music immersed, pot-smoking, beer-drinking teenager? Hey, *you* created this monster through your neglect.

With a high percentage of homes fatherless, working mothers have an even greater problem. Surveys have shown that fatherless kids tend to do much more poorly than those with two parents. I'm convinced that when we have a generation of better-educated kids we'll have fewer divorces and fewer one-parent homes. I think we can credit the increase in divorces to our lousy educational system.

Yes, there are other factors which permanently damage children—such as starting off with damaged genes from both parents resulting from their use of alcohol, nicotine, caffeine, and other drugs. Then there's the nine months of pregnancy, where the mother's drug use and poor nutrition both can damage the child irreparably, both physically and mentally.

The Sudbury Valley-type schools accept kids as young as four. Unless you really hate your children and want to do what you can to punish them for lousing up your life by being born,

Continued on page 40

How to Design Your Own HF Antenna

No excuses after this ...

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[pgebhardt@compuserve.com]

Not everyone has the opportunity to put up a tower with an HF beam on top. The problem may be space, it could be local law, or it might simply be money. Whatever the reason, if you don't have a tower and a beam, that doesn't mean you are limited to dipoles, single-element verticals, or random-length wires.

You too can have a directive antenna. It's a matter of taking a lesson from commercial broadcasters who use phased verticals as directive antennas. While amateurs have used phased verticals to a limited extent, there are more possibilities than have been fully exploited.

The two configurations which often appear in amateur radio books produce the broadside pattern and the cardioid pattern. These two patterns are shown in **Fig. 1**.

The problem with these patterns is that you might not be able to position the antenna so it radiates in the desired directions. The answer to this problem is to select a configuration which allows you to place the antenna in a convenient location, but will also allow it to radiate in your most frequently used directions.

Fig. 2 shows a bidirectional, endfire pattern, as well as a three-lobe pattern, which allow you to aim your signal in directions that cannot be achieved using the antennas shown in **Fig. 1**. Also shown is a four-lobe pattern, which combines the broadside and endfire ones.

The first step is to determine which configuration will work best for you. **Fig. 3** shows many possibilities using two vertical antennas. For example, with a pair of verticals positioned in a north-south line, you can use a cardioid pattern to aim your signal either north or south. The three-lobe pattern can also yield two directional patterns. You can have the lobes point north/southeast/southwest or south/northwest/northeast. The four-lobe pattern can be aimed north/east/south/west or northeast/southeast/southwest/northwest. As you can see from the chart in **Fig. 3**, there are even variations within these standard patterns.

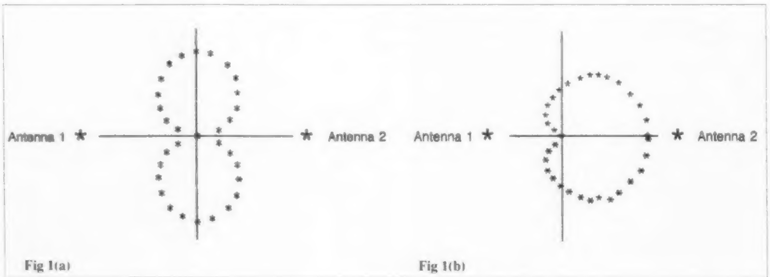

Fig. 1. Array configurations commonly described in amateur radio publications produce the bidirectional, broadside radiation pattern shown at (a) and the unidirectional cardioid radiation pattern shown at (b). The broadside array will transmit and receive in two directions which are perpendicular to the line joining the antennas. The patterns shown here are theoretical patterns in a horizontal plane. In this view, you are looking down on the antennas. The antenna locations are indicated by the asterisks.

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Lets you use coax from your antenna tuner to the MFJ-912 mounted outside your ham shack. The MFJ-912 converts the unbalanced coax to a balanced transmission line (ladder line). Provides same function as an internal balun except it is located away from tuner. Giant 2 core balun wound with *Teflon*® wire connected to high voltage ceramic feedthru insulators. Handles full legal power with ease. 3¼x2¼x7 inches.

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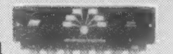
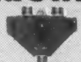


$39.95 MFJ-1701



$21.95 MFJ-1702B

$59.95 MFJ-1704

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MFJ-1701, $39.95. 6 position antenna switch. SO-239 connectors. 50-75 Ohm loads. 2 KW PEP, 1 KW CW. 10x3x1½ inches. DC-60 MHz.

MFJ-1702B, $21.95. 2 positions plus new Center Ground. 2.5 KW PEP, 1 KW CW. Insertion loss below .2 dB. 50 dB isolation at 450 MHz. 50 Ohm. 3x2x2 inches. **MFJ-1702BN, $31.95**, N-Connectors, DC-1.1 GHz.

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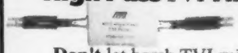

MFJ-711
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Don't let harsh TVI ruin your DXing and your wife's favorite soap opera! Keep peace with your family and neighbors.

MFJ's exclusive *ShieldBreaker*™ high pass filter effectively suppresses annoying TVI! Wipe out TVI caused by broadcast, commercial, two-way, amateur and CB radios operating below 30 MHz. Use between cable/ antenna and TV/VCR. For 75 ohm cable or 300 ohm twin lead.

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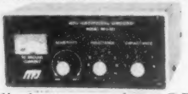

Creates artifical RF ground that eliminates or reduces RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding.

Greatly improves your signal if you're using a random wire or longwire antenna with an ineffective ground.

Electrically places a far away RF ground directly at your rig by tuning out reactance of connecting wire.

MFJ *Compact* Speaker Mics

MFJ's *compact* **speaker mics** have first-rate electret mic element and full size speaker gives superb audio on transmit and receive. Earphone jack, PTT, light-weight retractable cord. Gray. 1¼x2x3 in. **MFJ-284** fits Icom, Yaesu, Radio Shack and Standard. **MFJ-286** fits Kenwood.

COMPACTS: MFJ-284 or MFJ-286 **$19.95**

MINIS: MFJ-283, MFJ-285, MFJ-285L, MFJ-285W, MFJ-287 or MFJ-287L **$19.95**

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MFJ's *mini mics* give excellent audio from electret mic element and speaker. Has swiveling lapel /pocket clip, PTT button with transmit LED, earphone jack, lightweight retractable cord. Available with "L" or regular connector. Tiny 2x1¼x¼ inches.

Order MFJ-285/285L for Icom, Yaesu, Alinco, Radio Shack and Standard; **MFJ-287/287L** for Kenwood; **MFJ-283** for split plug Alinco; and **MFJ-285W** for IC-W2A.

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MFJ-108B dual clock has separate UTC and local time displays. Huge 5/8 inch LCD digits are easy-to-see. Brushed aluminum frame.

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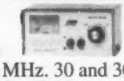

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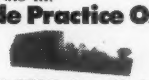
MFJ-264, $59.95. Versatile UHF/VHF/HF 1.5 KW load. Low SWR to 650 MHz, usable to 750 MHz. 100 watts/10 minutes, 1500 watts/10 seconds. SWR is 1.1:1 to 30 MHz, below 1.3:1 to 650 MHz. 3x3x7 in. *MFJ-264N, $69.95, N connector. MFJ-5803, $4.95, 3 ft. coax/ PL-259.*

Code Practice Oscillator



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"World Radio TV Handbook" says MFJ-1024 is a "first rate easy-to- operate active antenna...quiet...excellent dynamic range...good gain... low noise...broad frequency coverage... excellent choice."

Mount it outdoors away from electrical noise for maximum signal, minimum noise. Covers 50 KHz - 30 MHz.

Receives strong, clear signals from all over the world. 20 dB attenuator, gain control, ON LED. Switch two receivers and aux. or active antenna. 6x3x5 in. Remote has 54 inch whip, 50 ft. coax. 3x2x4 in. 12 VDC or 110 VAC with MFJ-1312, $12.95.

$129.95 MFJ-1024

MFJ Low Pass Filter

Suppress TVI, RFI, telephone and other interference by reducing unwanted harmonics going to your antenna. 9 poles, MFJ's exclusive *Teflon® Dielectric Technology*™ capacitors, hi-Q inductors, ground plane shielding, RF tight cabinet gives excellent TVI/ RFI protection. *Full legal power* 1.8-30 MHz. Mounting tabs. **MFJ-702, $24.95.** 200 Watts Low Pass TVI filter. 1.5-30 MHz.

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MFJ Multiple DC Outlet

MFJ-1118
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Use your rig's 12 VDC power supply to power two HF/VHF rigs and six or more accessories with this MFJ *high current* multiple DC outlet.

2 pairs of 30 amp 5-way binding posts separately fused for rigs. 6 switched, fused pairs for accessories. DC voltmeter, "on" LED, RF bypassed, 6 ft. of 8 guage power cable. 12½x2¾x2½ inches.

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MFJ-1112, $29.95. 6 DC outlets.

Cross-Needle SWR Meter

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Peak/ average Cross-Needle SWR/ Wattmeter. Shows SWR, forward/ reflected power in 2000/500 & 200/50 watt ranges. 1.8-60 MHz.

Mechanical zero. SO-239 connectors. Lamp uses 12 VDC or 110 VAC with MFJ-1312, $12.95.

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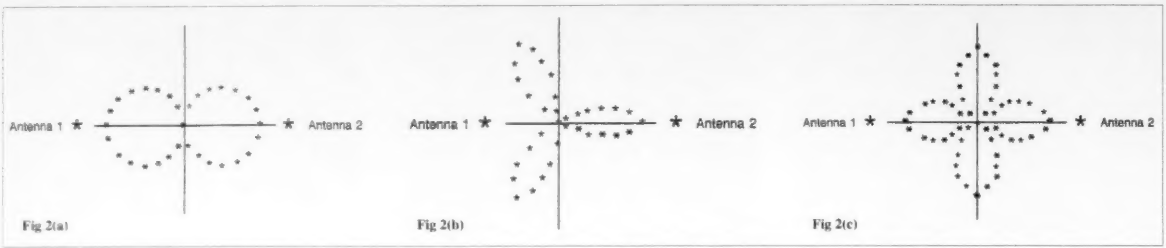

***Fig. 2.** It is possible to easily produce the bidirectional, endfire pattern shown at (a), the tridirectional (three-lobe) pattern shown at (b) and the quadridirectional (four-lobe) pattern shown at (c). The bidirectional, endfire pattern allows you to transmit and receive in two directions which are in-line with the antennas. The three-lobe pattern provides directions unattainable with either the broadside or endfire arrays, while the four-lobe pattern combines the directional properties of the broadside and endfire arrays.*

Of course, if you can align your array in a direction other than north-south, then you have even more flexibility in aiming your signal exactly where you want it to go. With all these possibilities, you can certainly find a pattern which meets your needs.

Since a single-element, omnidirectional vertical antenna will transmit and receive in all directions, you might wonder why anyone would bother with a directional array. The first reason is that the array concentrates the transmitted signal where you want it to go.

Second, in receive mode, the array improves the signal-to-noise ratio. This happens because the array does not respond to noise from all directions as an omnidirectional antenna does.

Third, you can cut down the amount of QRM. For example, (for amateurs on the east coast of North America) an array with a cardioid pattern pointed east will allow you to have QSOs with African stations while reducing QRM from stations to the west.

And last, this is what amateur radio is about—learning and trying new techniques which enhance your enjoyment of the hobby.

Seeing the radiation pattern on paper is one thing. Getting the array to perform the way you want it to is another. Here's how you do it.

First, choose the pattern you want to use from **Fig. 3**. Once you've chosen your pattern, note the spacing of the two antennas in degrees (numbers listed vertically on the left side of the chart). Also note the phasing of the antennas in degrees (numbers listed horizontally at the top of the chart).

You can convert the spacing from degrees to meters (or feet) using **Equation 1**.

s = (degrees/360) x (300/f)
Equation 1a

where
s is the spacing in meters
f is the frequency in MHz

or

s′ = (degrees/360) x (984/f)
Equation 1b

where
s′ is the spacing in feet
f is the frequency in MHz

Converting the phasing distance to meters (or feet) is only slightly more complicated.

Notice in **Fig. 4** that the signal is fed to Antenna 1 and then to Antenna 2. The two antennas are connected together using a phasing line (L1) made of coax. Since radio waves do not propagate as fast through coax as they do through air,

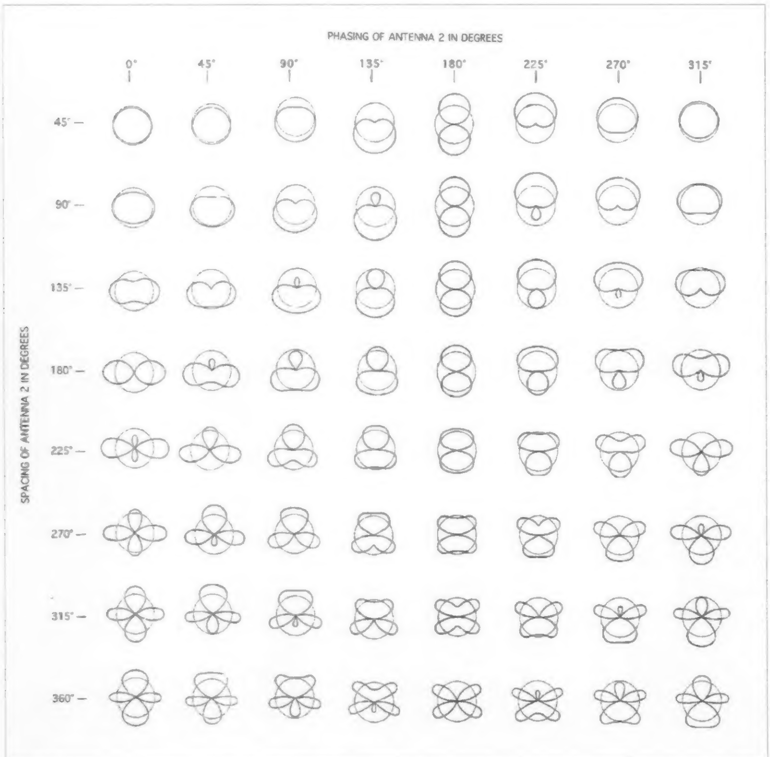

***Fig. 3.** This chart shows the many antenna radiation patterns which can be produced using two vertical antennas. Notice that many of the patterns are variations of the patterns shown in **Fig. 1** and **Fig. 2**. As shown in this chart, it is also possible to produce a pentadirectional (five-lobe) radiation pattern. (See the two patterns at the bottom right.) In this chart, Antenna 1 is at the top of each radiation pattern and Antenna 2 is at the bottom.*

you'll have to take the velocity factor (v) of the coax into account. The velocity factor of solid polyethylene-filled coax (standard RG-58 and RG-59) is 0.66. **Equation 2** is used to determine the length of the phasing line.

p = (degrees/360) x (300/f) x v
Equation 2a

where
p is the length of the phasing line in meters
f is the frequency in MHz
v is the velocity factor of the transmission line

or

p′ = (degrees/360) x (984/f) x v
Equation 2b

where
p′ is the length of the phasing line in feet
f is the frequency in MHz
v is the velocity factor of the transmission line

For example, let's assume that you want to erect a bidirectional, endfire array for use on the 10-meter band (28.5 MHz). In **Fig. 3**, Antenna 1 is at the top of each diagram and Antenna 2 is at the bottom. There is an array which meets your needs along the top row, fifth from the left. The spacing (s) between the antennas is 45 degrees and the phasing (p) of Antenna 2 is 180 degrees.

Applying **Equation 1a** gives a spacing (s) of (45/360) x (300/28.5) = 1.32 meters between the two antennas. The length (p) of the coax phasing line (L1) between the antennas according to **Equation 2a** is (180/360) x (300/28.5) x 0.66 = 3.47 meters.

So far so good. But what if you wanted to design a bidirectional, broadside array? Checking **Fig. 3**, you will see that there is one in the left column, fourth from the top. In this case, s = 180 degrees and p = 0 degrees. Applying **Equation 1a** gives a spacing (s) of (180/360) x (300/28.5) = 5.26 meters. The phasing line length (p) is (0/360) x (300/28.5) x 0.66 = 0 meters. Obviously, you can't have two antennas spaced 5.26 meters apart connected by a piece of coax zero meters long.

We need to return to basic transmission line theory to solve this problem. There are two solutions.

For the first solution, we know that as the radio wave travels along the coax, it repeats itself every wavelength (360 degrees). That means that there will be a 0 degree phase difference between the antennas if the coax is 0 degrees long, 360 degrees long, 720 degrees long, 1080 degrees long, or any other whole-number multiple of one wavelength. You could therefore connect the two antennas (using the configuration shown in **Fig. 4**) with a piece of coax 360 degrees long. Using **Equation 2a**, the length (p) is (360/360) x (300/28.5) x 0.66 = 6.95 meters.

The second solution to the problem is to feed the two antennas as shown in **Fig. 5a**. As long as L2 = L3, the signal will arrive at both antennas at the same time. That is, the phase difference between the antennas will be 0 degrees.

Either of these solutions can be used whenever s is greater than p, not just when p = 0 degrees as in the broadside array configuration just described. For example, if s = 270 degrees and p = 90 degrees, then p can be lengthened by 360 degrees to become p = 90 + 360 = 450 degrees. (The feed system used in **Fig. 4**.) Alternatively, the antennas could be fed as shown in **Fig. 5b**, making sure that L2 = L3 and L4 = 90 degrees. In practice, L3 and L4 would be one continuous length of coax.

Although **Fig. 3** shows that you can change the direction of the cardioid pattern (second row, third from the left) where s = 90 degrees and p = 90 degrees to the cardioid pattern (second row, seventh from the left) where s = 90 degrees and p = 270 degrees, there is a more practical solution to reversing the direction. You can simply switch the direction in which you feed the antennas.

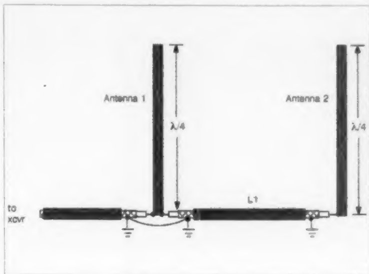

Fig. 4. *Two quarter-wave verticals are needed to produce the radiation patterns shown in* ***Fig. 3****. In the configuration shown here, your transceiver feeds one antenna (Antenna 1) as normal. However, a second piece of coax then connects the second antenna (Antenna 2) to the first antenna. Which pattern is produced depends on the spacing of the antennas and on the length of the phasing line (L1) connecting the two antennas. Not shown in this diagram are the ground radials used with quarter-wave verticals. The coax shield would be connected to the antenna radial system.*

Fig. 6 illustrates this. The arrow in the cube shows the direction of maximum radiation from the array. At (a), the signal will be transmitted in a direction in line with the antennas and from Antenna 1 toward Antenna 2. At (b), the signal direction has been reversed.

The flexibility of the array can be increased very easily. While it is not practical to adjust the spacing between the antennas, it is easy to interchange phasing lines.

For example, you might space the two antennas 225 degrees apart. When the phase between the antennas is 0 degrees, you have a bidirectional, broadside pattern.

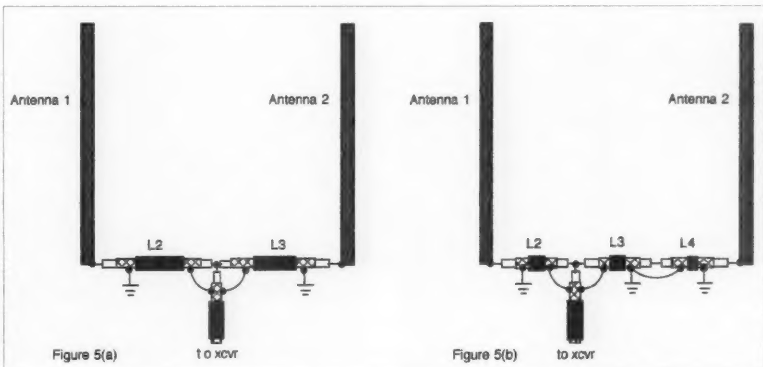

Fig. 5. *Sometimes it is more convenient or practical to feed the antennas as shown here. The feed arrangements are explained in the text.*

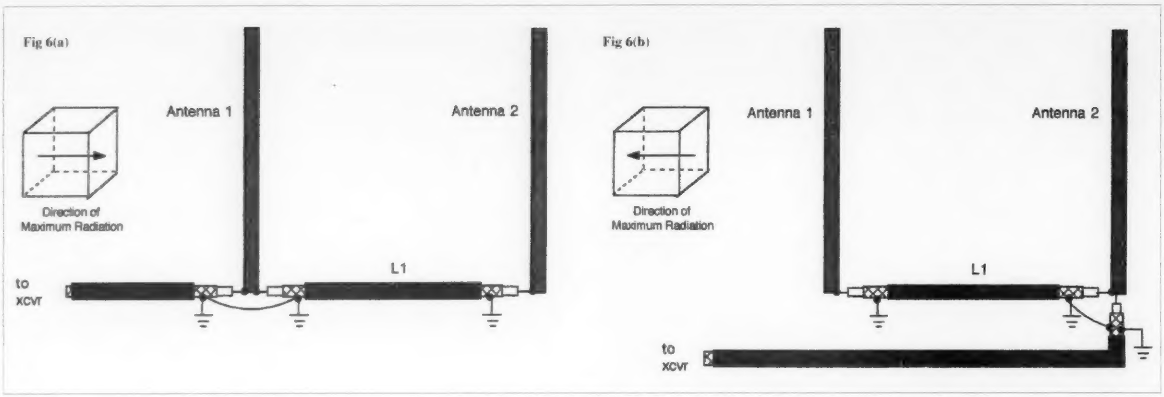

Fig. 6. *It is possible to reverse the array's direction of radiation by altering the length of the phasing line (L1). This approach, however, requires two phasing lines—one for each direction. It is possible to reverse the direction the signal travels by feeding the array in the opposite direction. For example, in the array shown at (a), the transceiver feeds Antenna 1 and the phasing line (L1) then feeds the signal to Antenna 2. In this case, the signal radiates in a direction from Antenna 1 toward Antenna 2 as shown by the arrow in the cube. The array at (b) uses all the same elements. However, the transceiver feeds Antenna 2 and the phasing line then feeds the signal to Antenna 1. This array will radiate in a direction from Antenna 2 toward Antenna 1. This is a good reason to use coax connectors at the base of the antennas rather than connecting the coax lines permanently to them.*

At 45 degrees, you have a three-lobe pattern. This pattern is altered by increasing the phasing to 90 degrees. For 180 degrees phasing, you have a bidirectional, endfire pattern. In addition, the direction of either three-lobe pattern can be reversed by changing which antenna is connected to the main transmission line.

Until now, I've assumed that the directional array would be a single-band antenna. Not so. For example, by using a pair of trap verticals, you could use the array on the 20-, 15-, and 10-meter bands. If you chose a spacing (s) of 360 degrees on 10 meters, then the same physical spacing would look like 270 degrees on 15 meters and 180 degrees on 20 meters. You could even use the same phasing line on all three bands. **Fig. 7a** shows one possible array.

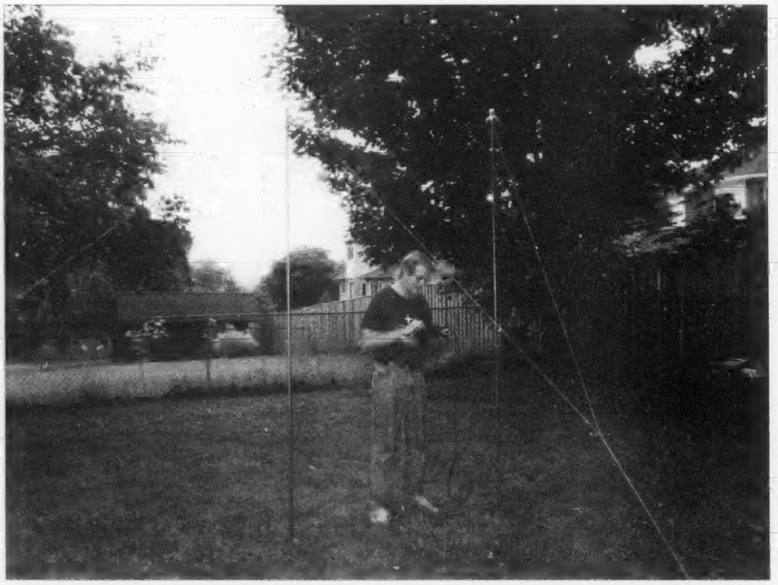

Photo A. *As shown by the author, directive antennas do not need much space. The two quarter-wave verticals used in this array for the 10-meter band are spaced 1/8-wavelength apart. The array produces a unidirectional cardioid pattern, one of sixty-four possible ones that can be produced using only two antennas and the information in this article. This single-band array can be turned into a multiband array by using trap verticals.*

Assume the 10-meter pattern selected sets s = 360 degrees and p = 0 degrees. The 10.52 m spacing (s) represents 360 degrees on 10 meters and the phase line length (p) is 720 degrees or 13.89 m. (A 720 degrees phase line is necessary because the two antennas cannot be connected using a 0 degree phase line. A 360 degree phase line is still too short to connect the two antennas, so the next length to give a 0 degree phase difference between the two antennas is 720 degrees.)

On 10 meters, this array will produce the four-lobe pattern shown in **Fig. 7b**. On 15 meters, the antennas appear to be spaced only 270 degrees apart and the phasing line now appears to be 540 degrees long (giving a phasing difference between antennas of 540-360 = 180 degrees). This produces the radiation pattern shown in **Fig. 7c**.

On 20 meters, the spacing is 180 degrees and the phasing line is 360 degrees long (giving a phasing difference of 0 degrees). The radiation pattern on 20 meters is shown in **Fig. 7d**.

There are many other possibilities. Keeping the 10.52 m spacing, the phasing could be set for 180 degrees on 10 meters. The phasing line would then be 135 degrees on 15 meters and 90 degrees on 20 meters. This would give three different radiation patterns from the ones shown in **Figs. 7b**, **7c**, and **7d**.

Alternatively, you could select a different spacing. For example, if the spacing (s) were fixed at 5.26 m, this would be 180

degrees on 10 meters, 135 degrees on 15 meters and 90 degrees on 20 meters. A phasing line 360 degrees long on 10 meters would appear to be 270 degrees long on 15 meters and 180 degrees long on 20 meters. This combination produces a different set of radiation patterns to choose from.

The feed system shown in **Fig. 7a** is identical to the system used in **Fig. 4.** It is also possible to use the feed system shown in **Fig. 5a**. What makes this configuration interesting in a multiband array is that the phasing is independent of frequency. Since L2 = L3, the signals will always arrive at the two antennas in phase (that is, the phase difference between the antennas will be 0 degrees).

Compare this feed method to the first multiband example above (s = 360 degrees, p = 0 degrees on 10 meters). Using the feed system of **Fig. 5a**, if s = 360 degrees on 10 meters, then s = 270 degrees on 15 meters and s = 180 degrees on 20 meters. So far, this is the same situation as before. However, in this case, p = 0 degrees on all three bands. So, while the radiation pattern on 10 meters will be the same with either feed system, on both 15 and 20 meters a different radiation pattern can be obtained depending on whether you choose to use the feed method of **Fig. 4** or the method shown in **Fig. 5a**.

A practical array

Here's how I built my directional array.

I wanted to try the array on the 10-meter band. Living in Canada, I decided that my best opportunities for DXing would be stations in the southern U.S., the Caribbean, Central America, and South America. Consequently, I decided on a cardioid radiation pattern. Checking the chart in **Fig. 3**, I selected the pattern for which s = 45 degrees and p = 135 degrees.

The necessary spacing (s) was (45/360) x (300/28.3) = 1.32 meters. The phasing line length (p) was (135/360) x (300/28.3) x 0.66 = 2.60 meters.

The array is shown in **Fig. 8a**.

Two practical considerations arose. First, a quarter-wavelength vertical antenna does not match 53-ohm coax (RG-58). If the phasing line is 180 degrees or 360 degrees long, that is not a problem. In either of these cases, the impedance at the load (antenna) end of the coax will appear at the input end of the coax. That is, the impedance of Antenna 2 will appear in parallel with Antenna 1 and the main transmission line from the transceiver will "see" two antennas with equal impedance.

Other lengths of phasing line (45 degrees, 90 degrees, 135 degrees, 270 degrees, 225 degrees, 270 degrees or 315 degrees) will effect an impedance transformation. In this case, the impedance of Antenna 2 will be transformed to a different value. As a result, the main transmission line will be connected to two antennas with different impedances. Consequently, the power will not be distributed equally between the antennas. The radiation pattern will then be distorted.

While you can accept this distortion and have a workable array, I chose to alter the phasing line impedance. I did that by running two 135 degree sections of RG-58 (53 ohms) in parallel to produce a transmission line with a characteristic impedance of 26.5 ohms. (See **Fig. 8b**.) By doing this, I avoided the impedance transformation.

The two 25-ohm antennas in parallel will produce an even lower impedance

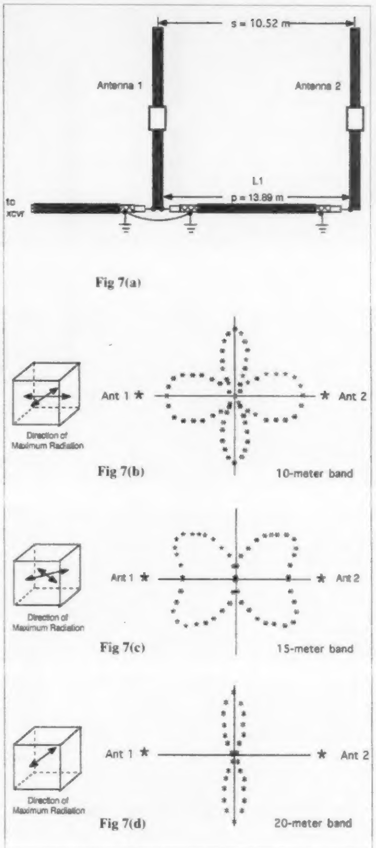

Fig. 7. While a phased array is often thought of as being a single-band antenna, it is possible to use an array on several bands—without changing the antenna spacing (s) or the phasing line length (p). The basic configuration for an array using trap verticals designed for 10-, 15-, and 20-meter use is shown at (a). The other diagrams show how the radiation pattern changes as you switch bands.

Photo B. Each antenna is supported on a glass insulator which is an inverted glass jar partially sunk into the ground. The 296 ml (10 oz.) jam jar shown here has a concave bottom that helps keep the antenna in place. The jar fits inside a 796 g (28 oz.) tin can which is sunk into the ground. The can holds the glass jar in place and provides an initial grounding point for the coax and the antenna. Radial wires are connected to the can.

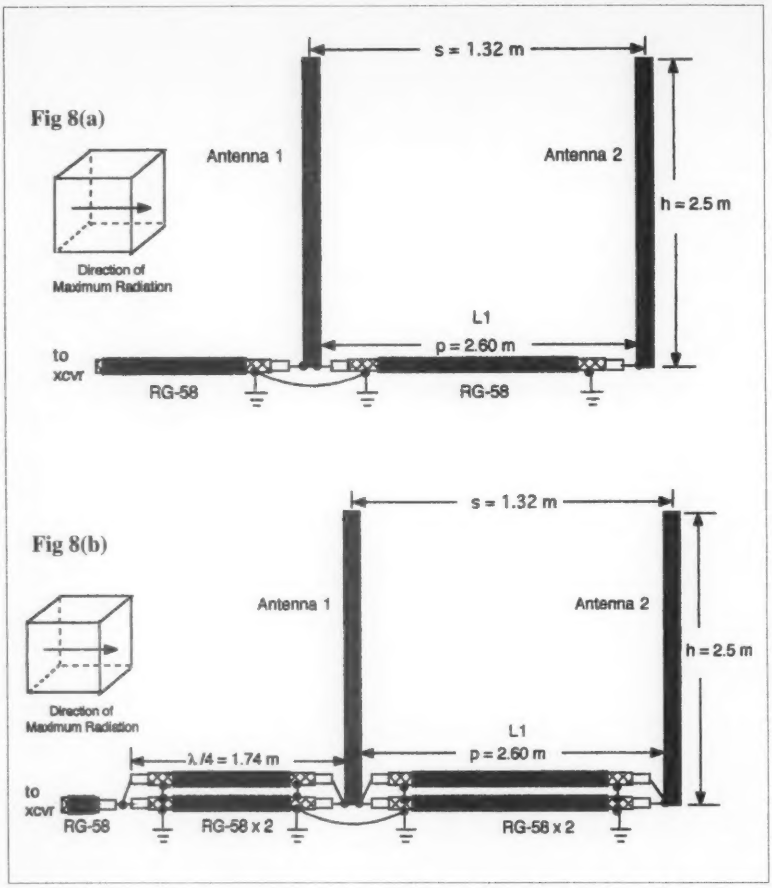

Fig. 8. *Shown at (a) is an array based on the information in* ***Fig. 3*** *to produce a unidirectional, cardioid radiation pattern. From my QTH in southern Canada, the array allows me to beam my signal to the U.S., the Caribbean, and South America. At (b) is shown a modified feed system to accommodate the low impedance to the verticals. The phasing line (L1) is made of two parallel sections of RG-58 to produce a transmission line with a characteristic impedance of 26.5 ohms. A quarter-wave linear transformer (Q section) is added between the main transmission line from the transceiver and the array. The Q section transforms the low impedance of the array to approximately 50 ohms. Like the phasing line, the Q section is made of two sections of RG-58 in parallel.*

as seen by the main transmission line. I corrected this by putting a quarter-wave transformer (Q section) between the main transmission line and the array as shown in **Fig. 8b**.

Let's assume the impedance of Antenna 1 and Antenna 2 in parallel is 12.5 ohms. The impedance at the transmitter end of the Q section can be calculated using **Equation 3**.

$Z_o = \sqrt{(Z_r \times Z_i)}$

so,

$Z_i = Z_o^2/Z_r$
Equation 3

where
Z_i is the impedance at the transmitter end of the Q section in ohms
Z_o is the characteristic impedance of the Q section in ohms
Z_r is the antenna impedance in ohms

If Z_o = 26.5 ohms (2 parallel sections of RG-58) and Z_r = 12.5 ohms, then $Z_i = 26.5^2/12.5 = 56$ ohms. As a result, the main transmission line from the transceiver would "see" a load with an impedance of 56 ohms—almost a perfect match.

Equation 4 is used to calculate the length of the Q section.

$\lambda/4 = (75/f) \times v$
Equation 4a

where
$\lambda/4$ is the length of the Q section in meters
f is the frequency in MHz
v is the velocity factor of the transmission line

$\lambda'/4 = (246/f) \times v$
Equation 4b

where
$\lambda'/4$ is the length of the Q section in feet
f is the frequency in MHz
v is the velocity factor of the transmission line

The length of the Q section for my 10-meter array was 1.74 m.

The feed system shown in **Fig. 8b** can be used to advantage with any of the arrays described in this article. If you apply this method to a multiband array, remember that while you need not change the phasing line (L1) when you change bands, you will need to construct a separate Q section for each band.

So now that you know how to aim your signal, why settle for a dipole strung between two trees when you can send your signal wherever you want?

Readin', Writin', and Robotin'

Is your high school entered in FIRST?

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The folks at FIRST (*F*or *I*nspiration and *R*ecognition of *S*cience and *T*echnology) have devised an exciting way to expose high school kids to engineering and technology. The program is the brainchild of Dean Kamen, a physicist, engineer, and entrepreneur from New Hampshire. His personal goal, and that of FIRST, is to show high school students how much fun engineering can be, encouraging them to pursue careers in technology.

Each year, Mr. Kamen and Professor Woodie Flowers, Director of MIT's New Products Program, create a game in which teams compete with radio-controlled robots. The game in 1997 was called "Toroid Terror" and the goal was to place colored inner tubes on a rotating eight-foot goal. On the surface, that may sound a little dull—but when three robots are in play at once, all competing against the clock and cheered on by a really excited crowd, you have the makings of a pretty wild time. Teams are encouraged to create stickers, buttons (for trading with other teams), tee shirts, hats, noisemakers, and whatever else might possibly contribute to the team identity.

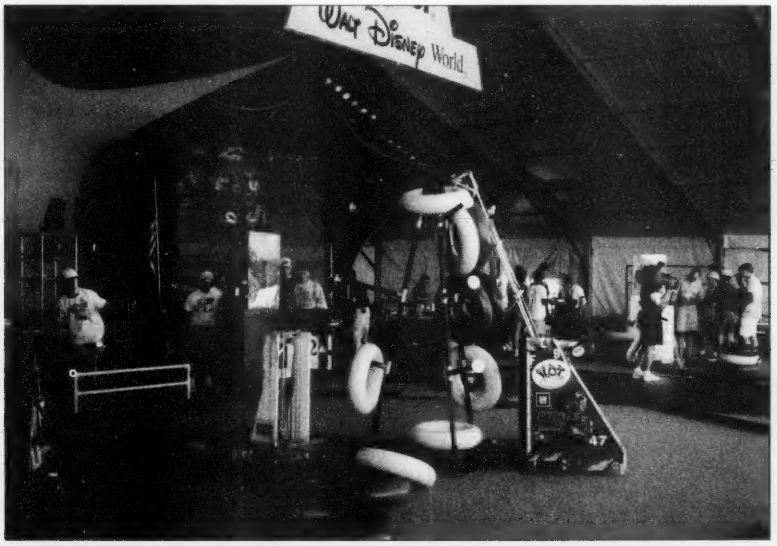

Photo A. *Author's GM/Huron Valley Team #47 robot places inner tube atop eight-foot goal for a double score.*

The students learn something about mechanical, electrical, electromechanical, pneumatic, and control systems in their quest for the perfect machine for the game. Students and engineering sponsors form cohesive teams very quickly. The teams have only six weeks to construct a machine of their own design from a box of parts supplied by FIRST. There is a tremendous amount of design latitude afforded by the variety of parts, as long as weight and dimensional restrictions aren't violated.

The fun doesn't end with tubes, gears, motors, switches, sheets, shafts, wire, and data radios. For the first time, in 1997 the controller supplied by FIRST was programmable! The language is a dialect of BASIC which the students can learn without much difficulty. The programming software runs on any IBM-compatible. FIRST supplies a default program

which functions perfectly well for those who don't want to write their own code. The example code is well annotated and easy to follow, so most teams feel confident in writing custom functions for their controllers. Some were very creative with their programming. At least one team used position sensors on rotating members for feedback to the controller.

Events

Regional competitions are held across the US beginning in March. All the teams learn a lot about strategy, which prepares them for the finals at EPCOT Center in mid-April. Both events are open to the public. FIRST could not have picked a better place than EPCOT for the three-day event. Disney and FIRST are about technology, fun, and the rewards of hard work. Students, teachers, technologists, and engineers learn from each other and have a great time doing it. All the teams show gracious sportsmanship, and some will even share tools, parts, and talent to help get a competitor's machine battle-ready.

This year (1997) was the rookie year for the General Motors Milford (MI) Proving Ground and Huron Valley (MI) Schools team. The team had a late start and worked several long weekends to catch up. The animation crew even worked all night to finish the video entry on time! The team placed 27th of 113 teams, and took one of two Rookie All-Star awards.

Awards

The Honeywell Leadership in Control Award goes to the team with the most unique control system. The team with the most robust design gets the Motorola Quality Award. Johnson & Johnson offers a Sportsmanship Award. Chrysler shows how much they value team efforts by presenting a Team Spirit Award. The Procter & Gamble Creativity Award is very broad, encompassing design and play criteria. Other awards are: Best Play of the Day, Number One Seed, Outstanding Defense, Most Photogenic, Best Offensive Round, Featherweight in the Finals, and Rookie All-Star. A highly qualified body of judges determines which teams receive awards.

Of the 17 awards possible, the Chairman's Award is the most prestigious. This award has nothing to do with winning the game. It has to do with student involvement, teamwork, creativity, and the level of cooperation between school and sponsor. The Founder's Award is presented by Dean Kamen to the person or organization which best promotes the goals of FIRST. The Autodesk Award goes to the team whose computer animation presents the best creative design solutions for the competition. The Woodie Flowers Award goes to an individual who excels in teaching math, science, engineering, and creative design. All the teams have an opportunity to vote on which team will receive the Worcester Polytechnic Institute Design Innovation Scholarship.

Want to get involved?

In these days of cellular phones and notebook computers, it's pretty hard to get kids interested in amateur radio as a vehicle into science and engineering. They need a really exciting project to light 'em up and get their scientific juices working so that amateur radio can be seen as the neat technical hobby it really is instead of an outmoded waste of time.

Would you like to be a sponsor or participant in the FIRST robotics competition? Every member of our team will assure you that the hours are long, but the rewards are great and it's worth every minute!

Our Friend Pythagoras

Pop quiz: Who can state the Pythagorean Theorem?

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Because I am an amateur radio operator as well as a member of the Civil Air Patrol, I am often involved in public service and emergency communications. Frequently during these events, we have need for an antenna support more reliable than motor vehicles or Mother Nature.

With this in mind, I started experimenting to develop the best means for setting up—and keeping up—the portable PVC masts we often use. But the method had to be easy for one person to implement, since helpers aren't always there when they'd be most helpful.

There is nothing magical about what I am about to explain. Those of you using a similar method know that it can save a lot of random running around.

It is common practice when erecting a mast to start by attaching the guys and halyard and then anchoring the base to some kind of pivot. After that you pick up the top of the mast, lift it over your head and start walking toward the pivot. If you can. Meanwhile, two or three assistants fan out with the guys to keep the mast from falling beyond center. Finally, the guy anchors are placed and the business of adjusting the lengths to hold the mast vertical starts. Then the antenna is hoisted on the halyard.

There's got to be ...

If you would like to try an easier way, here it is (see **Fig. 1**). We are going to replace Brownian movement with some planning and just a bit of engineering.

1. Select the location for the antenna's feedpoint. This will probably be near a spot where you can set up your comm station. Mark that spot with a small stake. Back off a reasonable distance, set up your camp stove and start some coffee.

2. If you are installing a dipole, unroll it and lay it in the desired orientation, with the center insulator at the stake you drove earlier. Attach and unroll the feedline.

3. Place the side guy line stakes for the center support mast. Measure this distance with a piece of cord the same length as the mast, and either drive the stakes now or mark their positions with a puff of builders' chalk. The cord is stored by wrapping it around the chalk bottle. The stake positions can be "eyeballed" or you purists can be more precise by checking the "constructions" chapter of any basic geometry text for information on constructing a perpendicular bisector to a line.

4. At each end insulator, drive another stake.

5. Using the cord and chalk, "puff" a circle around each end stake with a radius equal to the height of the mast. You don't need to use a lot of chalk—just enough to tell where the circle is (see **Fig. 2**).

6. At the point where the antenna wire crosses each circle, drive a guy line stake.

7. On the circle you have drawn around each end of the dipole, eyeball a point on the side opposite from the antenna and measure one radius each way around the circle. Place anchors at those points.

8. Attaching the precut guy lines is when the plan starts to come together. Remember the Pythagorean Theorem? $A^2 + B^2 = C^2$. What it really says is that the square of the height of the attachment point on the mast plus the square of the distance from the mast to the anchor stake equals the square of the length of the guy line. So, if the mast is 30 feet high and the anchor stake is 30 feet away, then the length of the guy line equals the square root of 900 plus 900, which equals 42.5 feet plus a little for good luck.

A 30-foot mast made of three-inch schedule 40 PVC seems to work pretty well with just top guys. If you plan to use more height or smaller diameter pipe, plan on more guy lines.

9. Attach the antenna insulators to the masts.

10. Go to one end of the antenna and while facing the bottom end of the mast, pick up the top and place it on your shoulder with the antenna and guys hanging behind you. The whole works is going to look pretty sloppy and floppy—especially if you are using one-and-a-half-inch pipe—but have faith and start pulling the base toward you. As you do so, the top will rise and the base will move toward

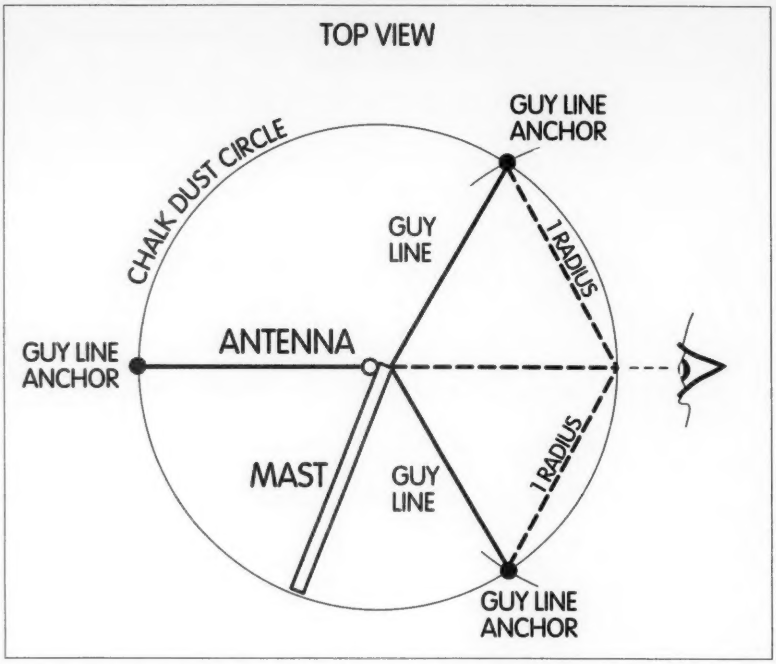

Fig. 1. Single mast detail. If everything is measured and cut beforehand, an antenna can be erected quickly in the field.

the center of the marked circle. Instead of you trying to lift the mast and the guy lines, they will work for you and make the whole process quick and easy.

11. Repeat Step 10 at the center mast and the other end of the dipole.

12. Do whatever fine tuning is required to accommodate irregularities in the terrain.

The coffee should be ready about now, so have a cup while you wait for the fellows with the rigs to show up.

Obviously, this method can be used to erect a single mast for an inverted vee or a lightweight VHF/UHF antenna. If the surface you are working on is too hard to accept stakes or too soft to hold them, you will have to do something else—replace the stakes with sandbags or perhaps buckets filled with rocks, or water, or whatever.

Give this method some consideration, try it at home, or perhaps at a club or unit meeting. It's fun, and it works!

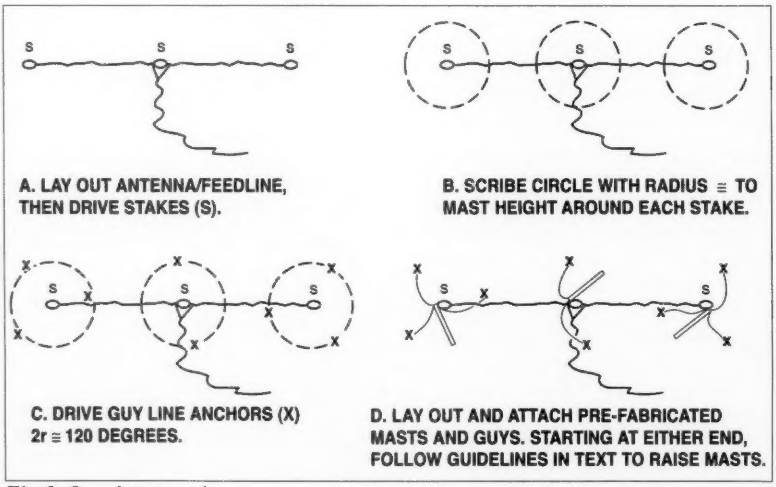

Fig. 2. Complete procedure.

Electronic Construction from A to Z

Everything you wanted to know about building stuff but were afraid to ask.

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As the doctor said to the patient, "I've got good news and bad news." The bad news is all around us—increasing prices, a decreasing skills base, no more Heathkits™ ... and if you want more, just pick up a newspaper. The good news is that you can still build a lot of useful ham radio equipment and you don't have to be an electrical engineer to do it. All it takes is the right tools, knowledge of a few "tricks of the trade," and the will to succeed. Oh, yeah—a bit of patience helps, too! We're going to try to cover the whole topic here in enough detail for you to pick up a soldering iron and get to work on a real project.

First we'll talk about the basics: things like tool selection and soldering; then we'll move on to middle-to-advanced techniques; and finally troubleshooting the finished project and installing it in an enclosure. Along the way we'll build something useful, I promise. You're going to discover that building is rewarding, educational, and fun!

Why build something when you can buy it?

There are several reasons for building (even if you only need one).

•Creativity. You have the pleasure and pride of doing something with your own hands. In fact, it's so rewarding that many of us will build a device even when building it is more expensive than buying it.

•Economy. Building is often less expensive than buying off the shelf.

•Availability. Sometimes what you want is simply not available, or available only as a kit.

•Knowledge. If you build it, you will probably be able to fix it if it breaks, or modify it. You will also gain a better understanding of how that particular type of equipment actually works.

These four factors will influence your decision to build something, and whether to buy a kit or start from scratch. The project that we will build together can be purchased as a kit, or built from scratch. Virtually everything in this series will relate equally to either approach.

A disclaimer, of sorts

I'm in the business. My company, Milestone Technologies, sells some of the tools that I am going to recommend and also the kit that we're going to do as a project. I'd hate to think that you would think I'm writing this series to sell stuff, so I will make a point of providing an alternate source for each of those items that I sell. Call me old-fashioned, but I'm tired of projects in other magazines which are thinly disguised ads for the author's own products. In the case of programmed devices, that's OK

Basic Hand Tools			
Item	Supplier	Price, $US (subject to change)	Part Number
Long-nose pliers	RS	3.99	64-1844
Cutting pliers	RS	3.99	64-1833
Screwdriver, reversible	RS	2.69	64-1950
Jeweler's driver combo set	RS	4.79	64-1959
Hobby knife	RS	1.49	64-1805
Magnifying glass *or* Jeweler's loupes (set of 3)	RS MT	5.99 7.95	63-848 35450
Multimeter, 8-range analog *or* Multimeter, 14-range analog	RS MT	14.99 9.95	22-218 30812
Clip lead set (10) mini alligator	RS	3.99	278-1156
Sheet-metal nibbling tools *or* Heavy-duty nibbling tool	RS MT	10.99 9.95	64-823 00539
Basic Soldering Tools			
15 W Soldering iron	RS	7.99	64-2051
Replacement tip for above	RS	0.99	64-2052
Solder, 60/40 rosin core .032" 2.5 oz.	RS	3.79	64-005
Solder wicking braid	RS	2.29	64-2090
RS - Radio Shack MT - Milestone Technologies			

Table 1. *Tools for basic kit-building.*

up to a point (almost all integrated circuits have proprietary content), but in a recent issue of a major magazine (not *73*) there were three projects, and not one of them could be built without buying something from the author! Making some of these things available to you from Milestone Technologies is a service which you are free to decline.

A poor workman blames his tools

A lousy violinist playing a Stradivarius is going to sound like someone scraping a horse's tail across a cat's gut. A great violinist can make a cigar-box violin sound like a Strad. Or to put it in more familiar terms, an unskilled ham will have trouble making contacts with a $3000 rig and a beam on a 100-foot tower, while a skilled operator can work DXCC on a homemade QRP rig with a dipole. The point here is that skill is more important than tools: Investing hundreds of dollars in tools and test equipment is not going to make you a good builder or technician. The value of your tool armory will increase as time goes by, but the basic tools for electronic construction are relatively inexpensive, and all of them are available at your local radio parts store and by mail order.

Let's talk about two basic tool kits for electronic construction: hand tools and soldering tools. The hand tools are really simple at entry level but even basic soldering tools start to get into areas of complexity, so you may want to read the section on soldering before deciding what to buy. The recommendations are summarized in **Table 1**, which shows suppliers' part numbers for Radio Shack (RS) and Milestone Technologies (MT).

Hand tools:

A pair of long-nose pliers, for bending the leads on components.

A pair of cutting pliers—what you are looking for are "flush-cutting" pliers rather than the traditional "dikes" or "diagonal-cutting pliers." These are used for cutting wire and trimming leads on the soldered side of a circuit board, and "dikes" just won't get close enough to the board.

You will need two large screwdrivers; one with a straight tip for slotted screws; the other with a Phillips™ head; and a set of miniature drivers. The mini drivers (often called "jeweler's screwdrivers") can be bought as separate sets for straight and Phillips, or as a combination set.

Hobby knife—for example, a Stanley™ knife, with a razor-sharp blade, for stripping wires and trimming things.

Multimeter for checking voltages, resistances, continuity, and current. A digital multimeter with an "audible continuity feature" is great, but you can get by with an inexpensive VOM (Volt-Ohm-Milliammeter).

Magnifier for examining circuit board traces and solder connections. If you can, you should solder under magnification, using a magnifying work lamp, but you can start with a hand magnifier or loupe.

Clip leads (wires with alligator clips on the ends for making temporary connections).

Sheet Metal Nibbling Tool for making large or odd-shaped openings in sheet metal—for example, aluminum panels for mounting controls. Much faster and easier than filing.

Soldering tools:

A soldering iron. That's so easy to say, but there's much more to it! We're talking molten metal here, in close proximity to delicate electronic components. When

you're working on a printed circuit board you need to apply a precise amount of heat for a reasonably precise amount of time to a *very* precise area! Your beginner's tool kit should include a 15-30 watt soldering pencil with a fine chisel tip and at least one spare tip. Ultimately you may want to invest in a "soldering station," but please buy one with temperature control rather than wattage control (see the section on soldering for details). You will need a much heavier iron (100+ watts) if you are going to work with coax connectors, but don't try to use it on a circuit board!

It's traditional to start out with a caution that you must use rosin core solder, never acid core solder, but in practice acid core solder is so hard to *find* that the warning is almost superfluous. There are three factors to consider: metallic content; type of flux (core); and diameter; and the result is a huge range of solders available on the market. For now, let's leave it with a recommendation that you start with 60/40 (60% tin, 40% lead) rosin-core solder with a diameter of around .03 inch. This will be fine for almost any kit or project and there's no point in departing from it until you have a particular reason to do so.

Solder wicking braid—you will make mistakes. I do ... everyone does. Besides, there will be times when you want to remove a component for testing, or to substitute a different value. The only practical way to unsolder a connection is with solder wicking braid. You'll see solder suckers and other "one-hand" desoldering devices, but if they are any help it all, it is because you used *way* too much solder on the connection to start with!

Your "work bench" is important, too, although it doesn't have to be elaborate. A kitchen table or desk will do. Things to consider are light, ventilation, and access to mains power and ground. When it comes to light, you simply can't have too much. Fluorescent light is best for electronics work because it is "whiter" than incandescent light. Ventilation is particularly important when you are soldering, because the fumes from the rosin can be irritating or even harmful over time. You will need mains power for your soldering iron, and you will often need to connect things to a good electrical ground (the center screw in the AC outlet will do).

Other than that, all you need to worry about is a reasonable amount of clear space, and places for tools and components. If you are using a space that has other purposes (i.e., your kitchen table) it's easy enough to keep your tools and components in trays so they can be easily put aside when you are not working.

Soldering 101

Entire magazine articles, even books, have been written about soldering. So how can I hope to teach you to solder with a few paragraphs and illustrations? Easy. Soldering is not difficult, and the basics are easily within your grasp if you have the right soldering iron, the right solder, and a little bit of practice.

Practice is important, so if you are new to soldering, please take the time to do some before we start on the project! You can practice on any old components and a bit of scrap circuit board material or skip ahead to unsoldering, remove a couple of components from a junk circuit board and resolder them. Kit suppliers will tell you that 90% of all problems in kit building are a result of poor soldering. How can that be, if soldering is not difficult?

Simple … carelessness and ignorance. We'll fix the ignorance problem right now—carelessness is up to you.

Soldering is a process of amalgamating metals to provide a good electrical connection. Solder is a mixture (alloy) of two or more metals with a relatively low melting point, that will flow onto the surface of other metals creating a low-resistance electrical connection. Ordinary solder is not very strong, and you should never rely on solder alone to hold components together physically. The mechanical connection should be secure before you apply solder, and the parts should not be able to move in relation to each other. The flux is vaporized by the heat of the iron and the vapors will clean the surfaces of any oxidation (often invisible to the naked eye), allowing the solder to flow freely onto the metal surfaces.

The purpose of the soldering iron is to transfer heat into the work to be soldered; the solder should melt upon contact with the work. The iron must be at the correct temperature to do this, and some elementary principles of thermodynamics are involved here. Fortunately, we don't have to worry about the details too much—a 15–30 W iron will heat up to an appropriate temperature and won't get too hot under ordinary circumstances. But let's look at the basics anyhow, because they will help you to understand what is going on, and also influence your decision to buy a temperature-controlled soldering iron later!

The wattage of an iron is a measure of the power that is used to generate heat. Your soldering pencil is always running at that level of power consumption, and it is always generating heat. The tip has a specific mass which can absorb heat. As long as power is supplied, it will continue to get hotter until it reaches equilibrium at its maximum temperature. Heat will be conducted away from it (into the surrounding air) as quickly as it is generated by the applied power. Heat will transfer out of the tip more quickly when it is in contact with the work—the rate at which that occurs will depend on the size and shape of the tip, the amount of its surface that is in contact with the work, and the nature of the work (how quickly heat is conducted away from the point of contact). When your soldering pencil is sitting idle it very definitely gets much hotter than required for soldering, but its heat drops almost instantaneously when you apply it to the work, and the applied power sustains the working temperature. When it's idle, though, at higher temperatures, its surface is much more susceptible to corrosion. So turn it off when you are not actually soldering (for more than five minutes or so). Otherwise, you can expect to replace or refinish the tip fairly frequently. Leaving it on overnight *once* will ruin the tip. Once the tip has been overheated and cannot be tinned (see below) you can file or grind it down and start over, but it is usually a lot easier just to replace it.

All else being equal, the wattage of an iron is a poor indicator of its performance because its main effect is in how quickly the iron will heat up to its maximum equilibrium temperature, or how fast it will create new heat for transfer into the work—not necessarily how hot that temperature will be! That's why the best irons, if somewhat more expensive, are temperature-controlled and not "variable output." I finally worked that out for myself after going through perhaps a hundred soldering iron tips.

From this point on, I'll be talking about soldering components onto a printed circuit board, but the principles apply to other soldering such as wire connections to controls.

Allow the iron to heat until solder flows freely on the tip, "tinning" it. This means there should be a thin, shiny coating of solder on the working surface of the tip—it should not "ball up" and drop off. Apply a small amount of solder to the tip and then wipe it off quickly with a soft cloth or a damp sponge. You can probably do three or four joints in immediate succession without having to repeat this tinning process, but if you stop soldering to place components on the board you will need to repeat it.

Here are the steps in soldering a component into a circuit board.

1. Inspect the board and the component leads, and make sure they are clean. Older components may be oxidized and require cleaning (use fine sandpaper, or scrape with the edge of your hobby knife). Most circuit boards do not require cleaning before use, but it can't hurt. Wash the board with soap and water, and use a mild abrasive (Scotch™ scouring pad, for example) or metal polish only if absolutely necessary. The surface of the tracks should be shiny and free of smudges and fingerprints. Some builders (and kit suppliers) will recommend cleaning a board before use and completing it in one session, but I have never found this to be necessary—that's why there's flux in the solder!

2. Mechanically install the component. Use your long-nose pliers to bend the component's leads so that they will go straight into the holes in the board. If the spacing permits, hold the lead with the pliers and bend the end of the lead against the jaws of the pliers. Otherwise, watch what you are doing and make sure you are not exerting excessive pulling force on the lead—you can easily ruin a diode or inductor by pulling on the lead. Check the value before you insert it in the board. If it is a polarized component such as an electrolytic capacitor, double check the orientation. If the component isn't polarized (for example, a resistor or ceramic capacitor) then it doesn't matter which way it goes, but it's a good idea to mount it so that you will be able to read

the value later. I usually put resistors in with the tolerance band to the right or bottom depending on how the resistor is mounted, and capacitors with the value facing me or to the right (unless they are very close to a larger component, in which case I turn them around). The aim is simply to make it easy to see and verify all of the component values after the board is complete. Before you solder it, *recheck* the value, the orientation, and that it is in the right holes! In most cases, the body of the component should be snug against the component side (opposite from the "track" or soldering side) of the boards. Obvious exceptions are transistors and other components which might run hot. Looking at the solder side of the board, bend the leads outward at about 45 degrees to hold the component in place.

3. Inspect the unsoldered connection. Make sure you know where solder is supposed to go. For example, if there is a pad for another component very close to where you are going to solder, you can memorize the pad layout and be sure that there is no unwanted solder bridge when you finish the connection. If you don't do this, it's often hard to tell whether two points should be connected or not. Examine **Fig. 3** for an illustration of this.

4. Solder the connection. Tin and wipe the tip of the iron as described above. Apply the tip to one side of the pad, wedging the tip against the lead where it protrudes from the hole, as shown in **Fig. 1**. Count to three and apply solder to the opposite side of the pad, and it should flow across the pad, around the lead, and slightly up the lead from the surface of the board. Do *not* apply the solder to the tip of the iron, as it will melt instantly and may flow onto the joint without bonding properly. **Fig. 2** shows a good joint and a bad joint. The bad joint is often called a "cold" joint because it is most often caused by inadequate heating of the joint. It doesn't just *look* ugly. If I can coin a new phrase here, it's "electrically ugly," offering no electrical connection between the two surfaces, or a weak one which is bound to fail, or (worst of all) an intermittent fault.

5. Inspect the soldered connection. Use a magnifying device of some kind, ideally 5–10x power, and make sure the connection is sound and conforms to the illustration in **Fig. 2**. Make sure solder hasn't flowed onto any adjacent pads or tracks. If it has, remove it immediately (see "unsoldering," below).

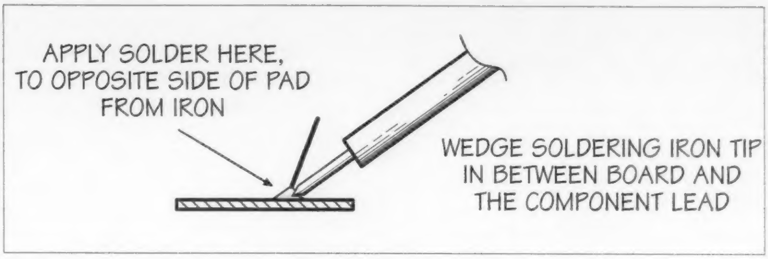

Fig. 1. Placing the soldering iron on the work.

6. Trim the component leads. Use your flush-cutting pliers and trim at about the point where the solder has risen up the lead. It is not usually necessary, or even a good idea, to trim the leads of integrated circuits and other devices where the leads protrude only an eighth of an inch or so.

That's all there is to it. With practice, you won't even need to think about the steps as you go through them. There are variations and some specialized techniques that will be helpful later, but usually they are self-evident, and we'll mention them when we come to them in the course of building our project.

When you've soldered all the components onto the board, check everything again—component values, orientations, and, above all, look for solder bridges and cold joints! When it comes to the latter two, it may be a good idea to remove excess solder flux from the board, but don't bother with that unless you really need to. In my experience, more problems are caused in the process of removing flux than are solved by it. If you do need to remove flux, use acetone or a commercial flux remover, in a well-ventilated area. If you have invested in solder with a water-soluble flux, you will use water, of course, but do make sure the board is thoroughly dry before applying power to it!

Unsoldering 101

For the most part, anything you can do with solder you can undo, if you know what you're doing. The secret is solder wicking braid, also called desoldering braid, a fine copper braid impregnated with flux. Used properly, it can remove virtually all of the solder from a connection. A component, even an integrated circuit chip, will just fall out. A lot of people seem to have difficulty with it, though. It's one of those things where it's hard to figure out how to use it by yourself. One big problem is that desoldering braid should be marked with a "use by" date! The braid itself can oxidize over time, and the flux can dry out and fall out of the mesh, making it practically useless. So use fresh wick, and do it like this.

1. Make sure the soldering iron is hot. Desoldering requires more heat than soldering, so if you have an adjustable iron, turn it up. And make sure the iron is tinned. That film of molten solder on the tip is essential for heat transfer into the work.

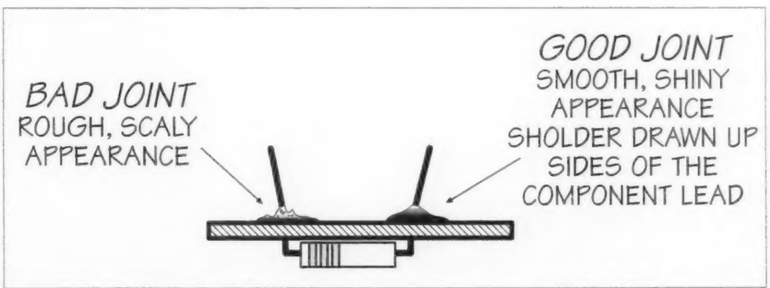

Fig. 2. Examine the work closely.

2. Lay the end of the wick on top of the connection that is to be desoldered, and press the iron firmly into the wick. Hold in place (you'll want to hold the wick by its container, or at least six inches from the end) and watch for solder to appear in the wick. When solder has been drawn about half an inch from the end of the wick remove the iron and the wick.

3. Cut the used end of the wick off, about a quarter inch above the point at which solder is visible. Solder has not been drawn up that far, but the flux has boiled out.

4. Repeat steps **2** and **3** until the component is free. It will usually take two or more applications for each lead. Keep in mind that where circuit board holes are plated through, solder has flowed down from the track side of the board and as a result there will be more solder to remove than on a simple single-sided board.

If you have trouble, remember that the two secrets are fresh solder wick and plenty of heat!

To repair (remove) a solder bridge, apply the wick to the bridge and the solder should be removed from the board between the two pads. You may need to resolder the connections, though.

Next time we'll build our project. In the meantime you can get your tool kit together, practice soldering, and order a kit. It's the VM-110 AC Voltage Monitor from Electronic Rainbow, and if you don't want to order the kit you can find most of the parts pretty easily. A list will be printed with the next of this series of articles, along with the schematic. The VM-110 kit costs $10.95 and you can order the complete kit or just the circuit board from Electronic Rainbow, or the complete kit from Milestone Technologies.

Sources:

Radio Shack: Call (800) 843-7422 for nearest location or to order by phone.

Electronic Rainbow Inc.
6227 Coffman Road
Indianapolis IN 46268
(317) 291-7269

Milestone Technologies, Inc.
3140 S. Peoria St., Unit k-156
Aurora CO 80014
(303) 752-3382
For Orders:
(800) 238-8205
E-mail: [sales@mtechnologies.com]
[http://www.mtechnologies.com/mthome]

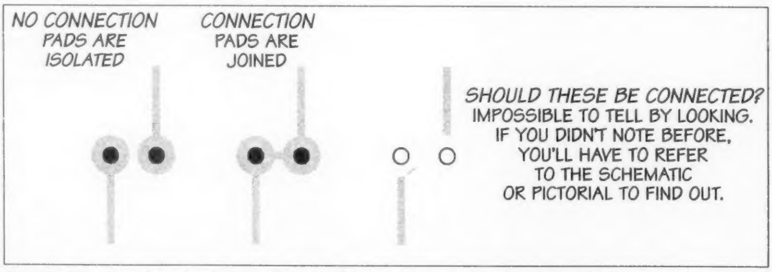

***Fig. 3.** Check and recheck for solder bridges, with a magnifying lens if necessary.*

The Table Topper 160-Meter Loop

Compact, low-noise—and effective.

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Slough SL2 1DA
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Many amateurs and SWLs find it very difficult, if not next to impossible, to erect an effective 160m antenna. First, there are those in "no antennas here" zones. Others do not have the space to erect an effective conventional antenna. And any who live in an urban environment will probably have to exist with a high noise level anyway, which may be so high that the band is impossible to use.

At my QTH I do not have the space to erect one. Even with a short loaded wire, the noise level is intolerable.

Noise at these frequencies is either atmospheric or manmade. Both types are picked up by the antenna, as is QRM. Atmospheric noises are radio waves, produced by natural causes, of irregular waveform and usually very short, repetitive duration. They cover a wide range of frequencies, and the noise level increases as the operating frequency decreases. This noise may be directional or non-directional, depending on the cause—an extreme case being nearby electric storms.

Manmade noise seems to be getting progressively worse as the years go by. It can be produced by inside sources such as thermostats; dimmer switches; TVs; computers and other electronic devices; and, of course, the main power supply—house wiring.

Externally, you can also pick up many of these noise sources from neighbors (especially in apartment complexes); external power supply cables; road traffic; neon signs; and so on.

Fortunately, much of all this noise interference is directional, and can be eliminated or greatly reduced by using a directional antenna such as a well-designed loop.

Coming back to the 160m band after some years' absence, I decided to design a narrowband, narrow beamwidth, small transmitting and receiving loop to specifically combat these noise problems on 160m.

Small, tuned-frame loops can be either solenoid-wound "box" types, or "spiral"-wound loops. With symmetrical matching/feeding, they should produce the well-known "figure eight" polar diagram radiation pattern, giving a theoretical zero signal null at 90 degrees to the line between the TX to RX signal path.

The box loop is the most convenient to construct, but unfortunately signals cannot be completely eliminated at 90 degrees. However, the more difficult to design and construct spiral loop can eliminate all signals at 90 degrees to the TX-RX signal path. Also, it does not need direct earthing/grounding.

The Table Topper 160 loop configuration

First, I constructed a spiral octagonal loop. This was tuned with a variable capacitor and successfully loaded with a low-power 160m CW TX. On a good RX, both European and trans-Atlantic signals came through when conditions were OK. However, living in south central England, I found that North American stations were received on the forward lobe, while European signals were recoverable on the reciprocal or opposite lobe. The nulling at 90 degrees effectively eliminated all signals. Noise levels were dramatically reduced.

I then conducted experiments with alternate shapes of spiral loops, using the same amount of wire turns and alternate methods of feeding/matching. At each stage, I did comparisons with the original octagonal spiral loop, the object being to (1) increase signal strength in and out and (2) if possible, reduce the size of

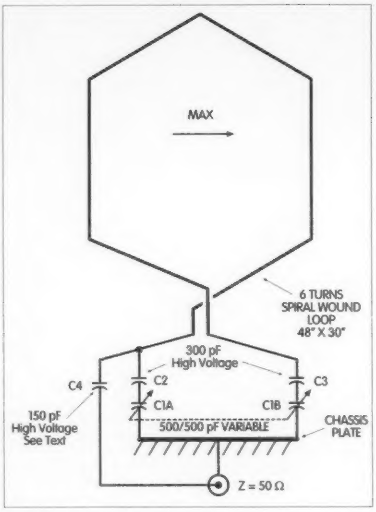

Fig. 1. Loop schematic.

the rear lobe while increasing that of the forward. This would reduce the reciprocal bearing QRM (on receive) and increase the signal strength on receive and transmit. Atmospheric noise would also be further reduced.

The final TT160 loop is shown in **Figs. 1** and **2.** I found that by reducing the loop's width dimensions and increasing its height, the signal strength significantly increased when compared with the original octagonal spiral assembly. The excellent nulling at 90 degrees was increased, too. Experiments also indicated that by adopting an asymmetrical feed, as in **Fig. 1**, the forward lobe could be increased and the reciprocal, decreased.

The end result was most satisfactory when the loop was pointed toward North America, where excellent W and VE signals could be heard, although the reciprocal European signals were greatly reduced. Rotating the loop through 180 degrees meant the opposite happened. Furthermore, the new shape and feed method gave the loop a narrower beamwidth which, with the loop's usual narrow bandwidth, reduced manmade noise and atmospheric noise to acceptable levels. The new radiation pattern was similar to **Fig. 4b**.

Loop construction

Refer to **Figs. 1** and **2** for the final loop assembly, just 30 inches wide and 54-3/4 inches in overall height, including the base mounting chassis. This is a size which can easily be accommodated on a tabletop and then stowed away when not required.

The TT160 consists of six spiralwound turns of PVC-covered wire (24/0.2 mm) with an OD of 2.05 mm and rated at 6 A. Any 6 A-minimum PVC-covered wire would suffice. The turns are supported by six-way terminal blocks, cut from 12-way standard ones (Radio Shack™ #274-679). It is important that the loop turns are wound counterclockwise starting at the outside and fed progressively through the terminal block holes. The inner wire end goes to a three-quarter-inch standoff insulator (**Fig. 2**), which ensures that the wire end drops down to the VC (variable capacitor) with a half-inch clearance away from the loop turns. The loop frame is made from well-seasoned hardwood as shown in **Fig. 2**.

The baseboard is 12 x 9 x 3/4-inch timber, onto which is mounted the simple chassis. This is a piece of 8 x 4 x 1/2-inch timber faced with single-sided copperclad Fiberglas™ board (8 x 4 inches), with the copper surface upwards. It is fronted by an identical board to form the panel. The copper surfaces of both boards should be seam-soldered together. At the rear of the baseboard is mounted a timber vertical loop frame support 13 inches long by one and three-quarter inches in diameter (see **Fig. 2**). The edge of this should be planed off to a small flat surface to allow the loop frame to be screwed to it as shown.

The two-gang by 500 pF-per-section variable capacitor (C1A and B) is mounted on the front panel. This VC should be of the larger, rigid, well-spaced, receiver type, with ceramic-mounted stators, which could well be salvaged from an old tube receiver. I used a Jackson type "L". In series with

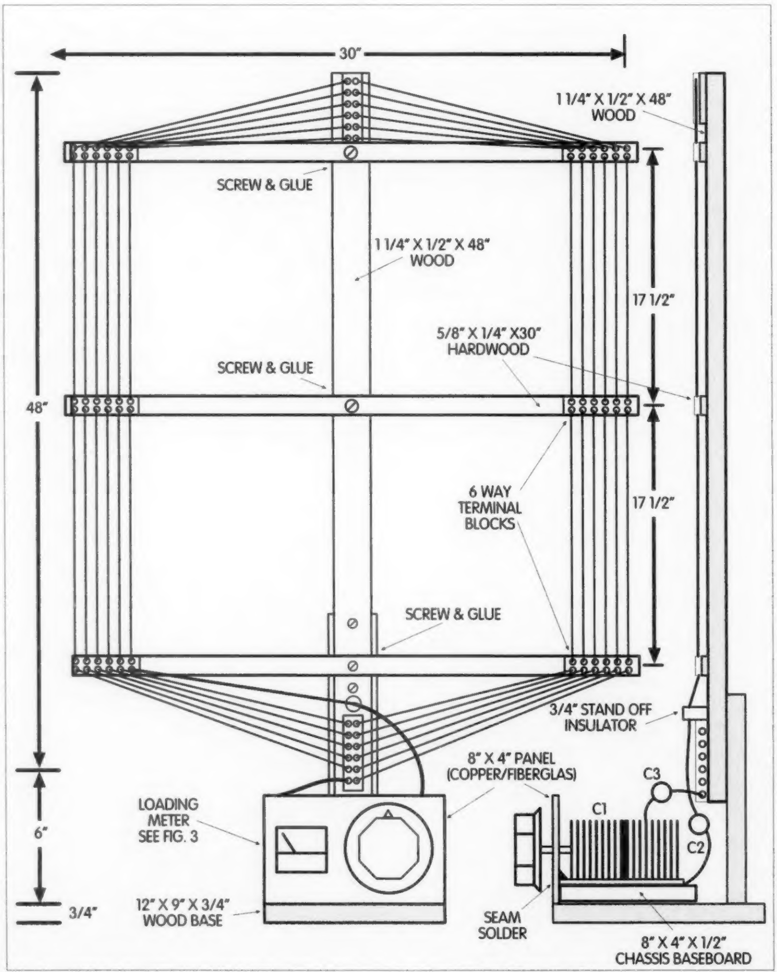

Fig. 2. Loop construction.

C1A and B are two 350 pF high-voltage ceramic disc capacitors (8 kV) which were from the junk box. Each is fitted to a small piece of perforated board and incorporated in the wiring between the loop and VC.

"There are no prizes for electrocuting the cat!"

The coupling loading capacitor (C4) is 150 pF high-voltage. Once again, an 8 kV rating from the junk box. The ceramic discs could be, say, 2 kV working, depending on what is obtainable. C4 couples the outer end of the loop winding to the 50-ohm coaxial socket, mounted facing the rear, so that the cable exits at the zero signal area of the radiation pattern.

Setting up and operating

The TT160 is fitted with a simple front-panel loading/tuning meter as shown in **Fig. 3**, consisting of a 250 µA meter with two diodes and a pickup coil. 1N4001 diodes were used, but any small ones would suffice.

The meter could be 100 µA if available. It is mounted on the front panel, as shown in **Figs. 2** and **3**. The pickup coil is a few turns of PVC hookup wire wound on a three and a half-inch length of three-eighths-inch diameter wood or plastic rod. Two pins are pushed through the rod, as shown in **Fig. 3**, forming the connecting point for the diodes and the pickup coil ends. The number of wire turns will depend on the type of meter and TX power used (see below).

No ground connection is required for the loop, although of course the TX and RX should be grounded.

The loop's narrow bandwidth ensures that no harmonic output, or TVI, can be detected when you are running about 15 watts CW. C1A and B have been found to be okay when tested up to just over 20 watts. If a much higher power is to be used, then a TX-type variable capacitor and thicker loop wire will be necessary. For safety reasons, higher power is not recommended for use in an indoor environment. There are no prizes for electrocuting the cat!

A simple loop-rotating turntable would be an advantage. This turntable should not be of the free-running ballrace type, since the stiffness of the coaxial cable would take charge.

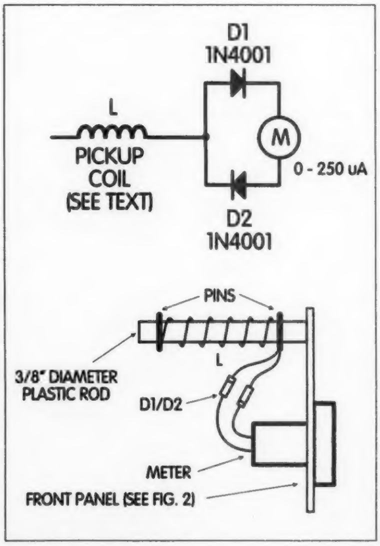

Fig. 3. Loading meter.

A few feet of RG-58 coaxial feedline should be connected between the loop and the TX/RX.

An operating frequency should be selected for the initial tests. The TX/RX should be loaded into a dummy load. On receive, the loop tuning capacitor should be carefully rotated to resonance by noting an increase in signal strength. Then rotate the loop for maximum signal, i.e., to the bearing of the station being received. Then, with a field strength meter nearby, switch to transmit. If necessary, readjust slightly for maximum indicated radiated signal on the field strength meter.

Next, put a few turns of hookup wire on the dowel rod and note the indication, on the panel microammeter, of the loading/tuning meter. The number of turns should be increased/decreased to the point where maximum radiated power from the loop produces about three quarters of a full-scale reading. The number of turns depends on the power of the TX. In the future, this three-quarter-scale meter reading will be your reference that all is well. When retuning the TX to another frequency, it may be necessary to slightly adjust the loop tuning knob to frequency, indicated by your maximum meter reading.

Remember: The bottom line for best TX performance is *maximum indicated output!*

The Table Topper 160 is an effective, low-noise, compact antenna. Its frequency range is 1600 kHz to 2000 kHz, with overlap at either end. It is equally useful for the transmitting and/or listening amateur, and will give a good account of itself as an indoor 160m TX antenna, too. No doubt someone will devise a remote control version for use in the attic—I'd love to hear about it.

On receive, the DX performance is quite dramatic when used with a good RX (no preamp being used). The low noise level, along with narrow beam- and bandwidth, ensures easy and comfortable listening. The TT160 has also been used for receiving DX and other beacons between 1600 and 1700 kHz. This also makes it a good prospect for those licensed for the MEDFER experimental transmitting band. Happy looping!

Suggested reading

Admiralty Handbook of Wireless Telegraphy, Vol. 2, 1938.

Antennas, Kraus.

Radio Engineering, Terman.

Handbook of Technical Instruction for Wireless Telegraphists.

Parts List

68 ft.	PVC-covered wire flex (24/0.2 mm), OD 2.05 mm, rated at 6 A. Other 6 A wire could be substituted.
1	500 and 500 pF 2-gang variable capacitor. Well-spaced rigid receiving type, with ceramic stator insulation. Jackson type "L" was used on the prototype.
4	12-way terminal blocks (RS #274-679), each bisected to form 8 6-way blocks
2	350 pF ceramic disc capacitors, 2 kV minimum
1	150 pF as above
1	3" diameter knob
2	8" x 4" Fiberglas™ single-sided copper board
1	1-1/2" x 1-1/2" meter (50, 100, or 250 µA)
2	Small diodes (1N4001 used)
1	3/4" standoff insulator
1	Wooden base 12" x 9" x 3/4"
1	Chassis, wooden baseboard, 8" x 4" x 1/2"
1	48" x 1-1/4" 1/2" hardwood, plus 13" x 1-3/4" diameter dowel
3	30" x 5/8" x 1/4" hardwood

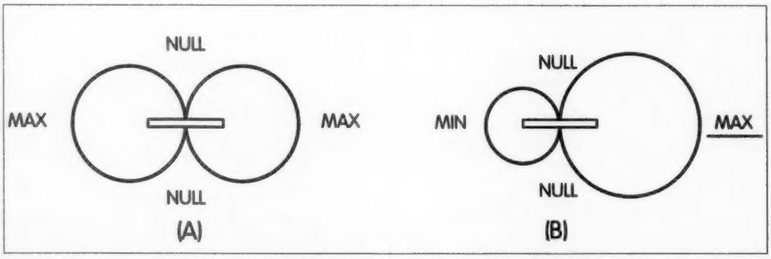

Fig. 4. (a) Theoretical figure eight radiation pattern of small loop. (b) Plotted pattern of the Table Topper 160.

Colby's Do Something Box

How about making a great gift gadget for the grandkids?

Evert Fruitman W7RXV
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Phoenix AZ 85017-2646
[Fruitman@asuchm.la.asu.edu]

For many years, scientists, engineers, and mothers have tried to find something for an active five-year-old to do besides watch TV and listen to the radio or tapes. Besides, these activities are not as interactive as hanging onto Mother's arm.

And although the sandbox makes a nice outside activity for kids, many times they need an inside one. *They* still want something to do that they can do all by themselves. *We* want them to do something that should not result in the partial destruction of the house or the partial loss of Mother's composure. With those thoughts in mind, I dug through the junk box and came up with the parts for my grandson Colby's "Do Something (besides annoy his mother) Box."

This Do Something Box consists of a number of basic building blocks. You may wish to start with just a few of them and add others later, depending on how the child's interest span—or yours—varies.

Of course, a normal five- or six-year-old will have a moderately long—or a moderately short—attention span (depending upon your viewpoint). That means that the Box should offer a variety of entertaining things for them to do. Most youngsters like blinking lights, wiggling needles, and especially noisemakers. Also, they want to change the speed of the lights, and the type of noise "all by themselves."

As a practical consideration, the Box should be portable to allow its use in any room in the house, as well as in the sandbox or in the car, especially during long trips. I still remember when our son, Colby's uncle, discovered the built-in interactive noisemaker in the back seat of our car. The first and the last time he snapped the top on the rear seat ashtray ensured that I was wide awake for the next several miles and trying to think of something else for him to do on trips. The Box should run for at least a year without someone having to change the batteries, and it should run on a pair of size D cells until they fall well below 1.2 V each. Also, it should turn itself off after a reasonable time. That will extend battery life and turn off the noise or the lights when it gets forgotten or "put away" during an impulsive moment.

Before you write to ask the editor if my spaceship is double-parked, let me say that Colby has been using his Box for two years. Both he and his mother like it, particularly because of the relatively quiet noisemaker, the auto turn-off feature, and the fact that they have not had to change the batteries yet.

Overview

Fig. 1 breaks down the Box into its individual blocks. It consists of (1) the battery; (2) the time delay/auto turn-off switch; (3) the blinking LEDs; (4) the sound generator; (5) the battery tester; (6) the meter driver; and (7) other options—something else that you want it to do. You will see how each basic building block works, and then put the whole system together. Of course, if you have more interest in getting it together than in how it works, skip to the construction section right away.

The battery

For practical reasons, the unit should run at least a year before it needs a battery change. I used a box without the little battery access panel. "An ounce of prevention ... " keeps them from opening the battery compartment and losing the batteries, or worse.

Size D cells should run a light load like this for at least a year of normal, intermittent use. Smaller batteries would

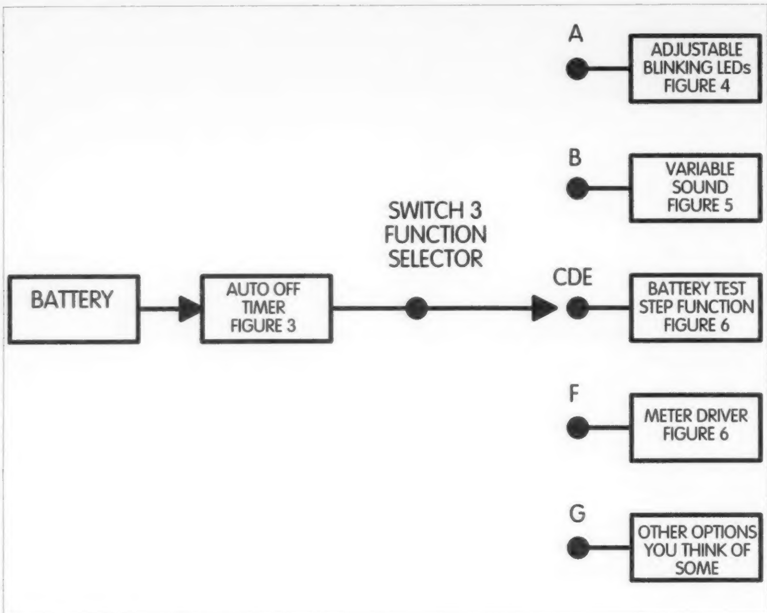

Fig. 1. Block diagram.

make the Box smaller and would probably run it a reasonable time, but you can find the D cells at just about any hardware store. Without the battery access panel, you have to dig up a screwdriver and take it apart in order to change the batteries. This latter feature is designed to keep Junior from doing it himself. Of course, you can customize this project to suit your wishes. If you want, you may use AA or even AAA batteries and expect reasonable life from the batteries thanks to the relatively low current drain and the auto turn-off feature.

Time delay, auto turn-off

For many years, calculators have used the auto turn-off feature, but they use a rather small amount of power, typically 3 V at a few microamps for the LCD type of calculator. Applying that idea to a toy that draws a moderate amount of current, 2–20 mA, presents something of a challenge.

Using a relatively low supply voltage precludes the use of just a Darlington pair as the main element in the switch. A Darlington pair is the stacked dual-transistor circuit that has a high input impedance which lends itself to the auto turn-off feature. In this case, though, the cascaded junctions would use up too much battery voltage and limit the useful life of the batteries, or make it necessary to use more batteries. **Fig. 2** shows a Darlington pair driven by the voltage from a capacitor. The Darlington pair drives a relay in a time-delay circuit.

As the capacitor charges or discharges, the relay will change states—turn-on or turn-off. Pushing the START button will charge the capacitor through RA. When the voltage across the capacitor reaches about 1.2 V, QA and QB will start drawing current through RB, their emitter-base and their emitter-collector circuits. The emitter-base current in QA will cause, say, one hundred times the current to flow in its emitter-collector circuit. Since the emitter of QA goes directly to the base of QB, any current in the emitter of QA must flow through the emitter-base circuit of QB. That current, in turn, is multiplied by the gain of QB, which results in much more current flowing through the emitter-collector circuit of QB. In this case, that includes the relay. This so-called "piggyback" configuration is called a Darlington pair.

The Darlington pair can take a few microamps in the first base and multiply it to the milliampere level in the collector of the second transistor. A quick example will help show this. A 2N3904, QA, has a minimum DC current gain of 150. Connecting two of them this way gives us a minimum current gain of 150 x 150 or 22,500. Feed 1μA (0.000001 A) into QA and QB can deliver a nominal 22.5 mA (0.0225 A) to the load. Since a relay may want five times that much current, or 100 mA, you would need to feed 5 μA into QA. Not bad, since that would represent a nominal 240,000 (240 k) ohm load to the timing capacitor. (I will save the math on that one for another time.) With a reasonably-sized capacitor, you can get a useful time delay for the relay out of this circuit.

By placing a resistor between the capacitor and the base, as well as a resistor between the emitter of QA and the base of QB, you can make the resistance across the capacitor go up quite a bit. That will give many minutes instead of several seconds of time delay without putting in a larger capacitor. While you can use this improved circuit to drive a relay, a relay draws more current than you want to use for the Box. In fact, the relay draws more current than the rest of the project. So you will do something else to make an automatic off switch for your Box. We will modify the switch circuit so that it drives a single transistor. That will take the place of a relay to turn on your Box.

One more thing about this simple Darlington pair relay driver circuit. Connected this way, the output transistor has about 0.7–1.2 V across it, even if the base of QA has a lot of drive, base current, fed into it. With a relay as the load, the missing nominal one volt does not make that much difference in the way the circuit works. A 12 V relay will turn on with less than 10 V across it. That is fine if you have a 12–14 V supply. Our Do Something Box has only three volts available. So, in this case, a single power

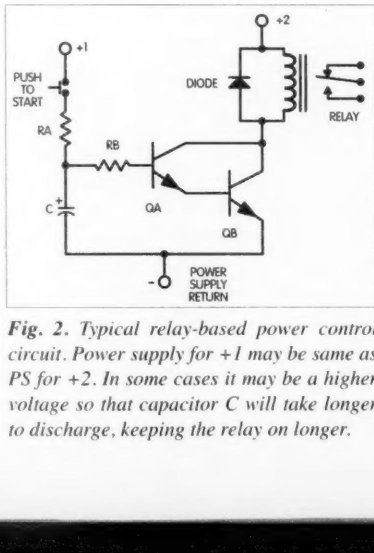

Fig. 2. Typical relay-based power control circuit. Power supply for +1 may be same as PS for +2. In some cases it may be a higher voltage so that capacitor C will take longer to discharge, keeping the relay on longer.

transistor will be used as the on/off switch. It can have as little as 0.05 V (50 mV) lost across it.

You can determine the most current that the circuit will draw, then find a power transistor that can deliver that amount of current. A power transistor has to have some current driving it, as does a relay. A suitable transistor, however, will draw less base current than a corresponding relay. The relay coil may draw 100 mA–200 mA, while a transistor could turn on the same load with only 1 mA base current. Base current does to a transistor what current in the coil does to a relay. Most relays are designed to handle much more power than this little Box draws. A transistor makes an ideal on/off switch for this project. As a bonus, since the transistor has no moving parts, you will find it more reliable, cheaper, and easier to get than a relay.

The circuit that looks at the voltage on C1, the timing capacitor, must draw the smallest possible amount of current as the capacitor counts down the turn-off time. By using a combination of the Darlington pair and a complementary pair, you can get the desired high resistance across the timing capacitor and still have a low-loss on/off switch. If the capacitor sees a low resistance, you will get only short timing with practical values of capacitance. The working circuit is much simpler than it sounds.

Look at **Fig. 3**. With the values given for C1 and R1, the simple auto-off switch gives about 15–20 minutes run time and only 0.03 V, 30 mV, loss across Q3. That makes Q3 a respectable switch at these current levels. The switch losses can and do go up at higher current levels.

When you push the START button, C1 charges through SW1 to the battery voltage. Some applications need resistor RA in **Fig. 2**. You do not need that resistor to limit the input current here, so you may leave it out. R1 limits the current from the capacitor, C1, into the base of Q1. It also raises the input impedance of what the capacitor sees, thereby giving reasonable ON times with practical parts. With R1 = 82 k ohms; and C1 = 22 µF, the circuit gives about 10–15 minutes run time.

When the voltage across C1 reaches about 1.2 V, current flows through the emitter-base junction of Q1, R1, and the emitter-base junction of Q2. That causes Q1, Q2, and Q3 to turn on. When Q2 turns on, current flows through R2 as well as the base-emitter junction of Q3, turning it on.

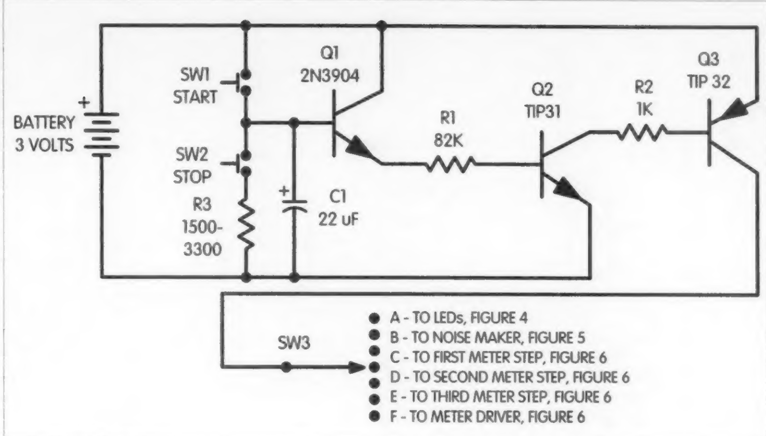

***Fig. 3.** Auto-Off switch.*

Q2 and Q3 form a complementary pair: in this case, a direct-coupled NPN and PNP transistor. When Q2 turns on, it causes Q3 to turn on, which supplies current to the part of the Box selected by SW3. Here, a modified Darlington pair samples the voltage across the timing capacitor. Note that the collector of Q1 goes directly to the plus supply line. That eliminates the usual higher voltage loss a Darlington pair has across the output transistor, Q2. Although you still have two emitter-base junctions in series across the capacitor, they combine with R1 to give an exceptionally high impedance across the timing capacitor. That gives a long-time-delay auto-off switch. In case you were wondering, Yes, you could do all of this with an op amp. But, you would have to use a higher supply voltage or look for a harder to find, special low voltage op amp.

Pushing SW2 connects R3 across C1, the timing capacitor. The 1500–2200 Ω resistor bleeds the charge off the capacitor in a fraction of a second, turning off the Box. This gives you the option of a manual turn-off. Without R3, if or when someone pushes both buttons, it would place a direct short across the battery.

The resistors R1 and R2 supply the bias currents to Q2 and Q3. R1, Q1, and to a lesser degree, R2, set the load seen by capacitor C1.

Here is one of the useful things about this modified Darlington pair, Q1, Q2, that you may want to put into your notebook. The input impedance, looking at the left side of the base of Q1, is set by the value of R1 multiplied by the DC current gain of Q1. With a 2N3904 and a value of 390 k ohms for R1, the input impedance of Q1 (at the base) is ~390,000 x 150 or 58 meg (million) ohms. That gives you what the capacitor likes to see in order to give the switch long ON times, a high impedance load. Simply stated, the switch needs only a few microamps to turn it on. With this circuit, you can get that from a small capacitor for many minutes. That makes the switch practical. It also makes the Darlington pair useful for other applications.

Start your timer

This timing circuit turns on as soon as you hit the START button, and for quite a while it maintains practically the full battery voltage across the load. However,

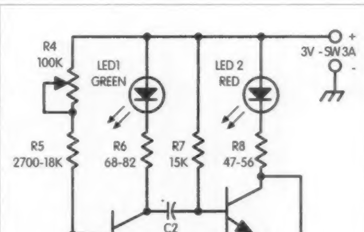

***Fig. 4.** LED driver.*

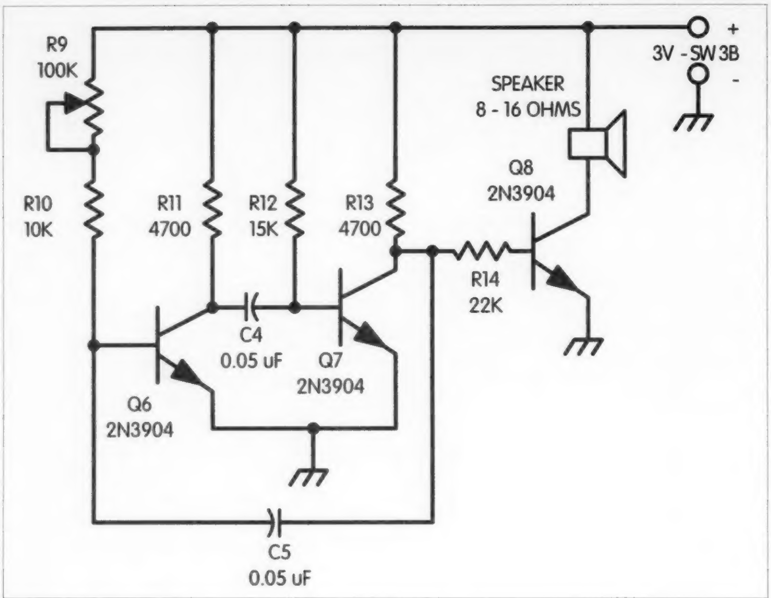

Fig. 5. Sound generator.

after a while it tends to fade from a certain point in the shut-down sequence before making a complete turn-off. This happens as Q3, from **Fig. 3**, starts to fall out of saturation. As it starts to develop a higher voltage drop across its emitter-collector, it becomes a less efficient switch.

As the voltage across the switch increases, the voltage across the rest of the circuit decreases. It still works, but the LEDs get a bit dimmer or the sound from the speaker gets softer. Some systems require a sharp turn-off, but not this one. So you can use a simple, cheap, but somewhat sloppy switch, as part of a toy that turns on at the push of a button and remembers to turn itself off without a reminder from anyone. Like the other basic building blocks described here, you could find other applications for this switch. You might have to adjust some of the circuit values to fit your other applications.

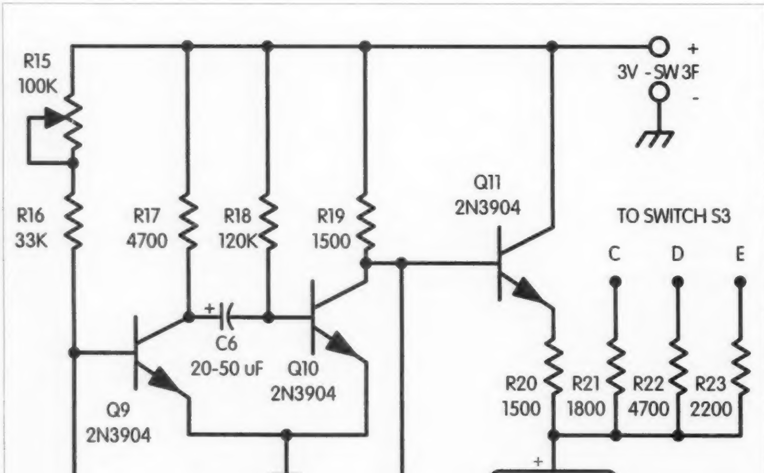

*Fig. 6. Meter driver. See **Table 1** for R20–R23 values for other meters.*

LED driver

Here you have another basic building block, the astable multivibrator. Its formal name means that one of the transistors will turn on for a while and the other one will turn off; then they will switch. It cannot have one of the transistors turn on, and the other one off, and stay in that state. Because one of the transistors turns on and the other transistor turns off, then after a period of time, they change to the other condition, this circuit is commonly called a free-running flip-flop. This is another one of those simple but versatile circuits.

When the LED flasher in **Fig. 4** first gets power, one of the transistors starts conducting first. It turns on because of the bias supplied by the resistor from the base to the plus supply. That also causes the capacitor connected to its collector to charge through the other base-bias resistor. While it is charging, the voltage at its far end (the end connected to the base of the OFF transistor) is too low to turn on the second transistor. When the capacitor finishes charging, the voltage at the base end of the capacitor rises enough to turn on the second transistor.

Because the capacitors connect the collector of one transistor to the base of the other transistor, the action will continue. One transistor will turn on while the other one turns off. The capacitors alternately charge and discharge. The rate at which this happens depends upon the value of the resistors and the capacitors. The size of the capacitors and the base bias resistors have the greatest effect on the speed at which the capacitors charge and discharge.

The resistor and capacitor values set the frequency of the action. You may choose these values so that it takes so much time for the transistors to switch back and forth, you can almost keep track of them by postcard. At the other end of the scale, you can use small enough resistor and capacitor values so that the transistors will switch on and off several hundred thousand times per second. For

this application, you will use values that will cause the LEDs to blink at a moderately slow rate so that our eyes can follow them.

The combination of the RC values for the meter circuit, **Fig. 6**, will cause it to tick-tock about once every couple of seconds. The values chosen for the noisemaker function, **Fig. 5**, will produce a sound that ranges from the low end up toward the middle of the piano. Colby's Box has a nominal 4-to-1 (two-octave) range. The same basic circuit—but with different values of R and C—will give a wide range of frequencies out of this simple oscillator. That will allow its use in several different applications.

Changing the speed or the sound (all by myself)

By varying the value of the base resistor, you may vary the time constant and therefore the frequency of the oscillator. A potentiometer (volume control) wired as a two-wire control makes a convenient way to vary the base bias and, more importantly, the RC time constant. This has been done with R4 in **Fig. 4**, and another pot could be added in series with R7. This would allow tweaking for equal on-off times.

You *must* include a fixed resistor in series with the pot(entiometer). Without the fixed resistor to limit the current, when the pot gets to the end of its travel with the least resistance in it, it would connect the emitter-base junction of the transistor directly across the battery. That would destroy the transistor. Once the emitter-base junction starts conducting, at about 0.55-0.7 V, you *must* limit the current through it. The same goes for the LEDs as well as other PN junctions such as rectifier and signal diodes. The resistor in series with the collector and the LED limits the current to a safe value. It is large enough to limit the current but small enough to give a reasonably bright light.

Noisemaker

The noisemaker uses the same basic circuit as the LED flasher, but with a slight change of values. That changes the timing and the frequency. It also has one more transistor in it. That added transistor isolates the relatively heavy load from the basic flip-flop or, as I call it, the oscillator. Since the speaker draws a lot of current, it looks like a heavy load.

In **Fig. 5**, you can see a resistor, R14, between the collector of the second transistor and the base of the speaker driver. In essence, when the second transistor turns off and on, it alternately supplies and removes base drive to the output stage Q8. Since this happens at an audible rate, the current through the speaker turns on and off, producing sound. An audible rate simply means a rate from 20 to 20,000 times per second. That is the textbook definition of frequencies in the audible range (no, I cannot hear anything above 12,000 anymore). Changing the value of R9 makes the sound vary from a low buzz to a high-pitched squeal.

The collector resistor, R13, of the second transistor, Q7, would limit the current in the emitter-base junction of the output transistor Q8. However, without the 22,000 Ω resistor in series, the e-b junction of Q8 would look like a low resistance load across the second transistor. That would upset the timing circuit (understatement!)

If you want more noise out of this section, you may use a somewhat smaller resistor, a Darlington pair for the speaker driver, or both. Speaker impedances other than 8–16 Ω will work, but the volume will vary accordingly. Putting holes in the Box may make it loud enough without having to add parts. I suspect that Colby's mother enjoys the somewhat quieter sound more than he does. When he gets a little older and can read this, he may want to change it.

Meter driver

Before getting into "how and why" the meter circuit works, I will point out a couple of things in general about the meter. At one time, you could find analog meter movements at surplus stores or used meters in your spare parts box. Today, they are somewhat less available. Also, the price has gone up, making most new meters too expensive for a project where their delicate mechanical nature may get tried to the breaking point.

An analog meter movement usually consists of a coil of fine wire suspended between the poles of a permanent magnet. Older meters used pivots on jeweled bearings (lower friction). Better meters

Meter Sensitivity	R20	R21	R22	R23	Standard Values Used to Make the Needed Resistance
50 µA	48 k	330 k	30 k	60 k	48 k = 47 k + 1 k, 30 k = 15 k + 15 k, 60 k = 56 k + 3900
100 µA	24 k	180 k	15 k	30 k	24 k = 22 k + 1800 *or* 22 k + 1 k + 1 k, 30 k = 15 k + 15 k
200 µA	12 k	90 k	7500	15 k	90 k = 82 k + 6800 + 1200, 7500 = 6800 + 680
500 µA	4800	36 k	3000	6 k	4800 = 4700 +1 k, 36 k = 33 k + 2700, *or* 33 k + 1500 + 1500, 6 k = 5600 + 390
1000 µA 1 mA	1500	18 K	1500	3000	
5 mA	NR	3600	270	600	

Table 1. *Resistor values versus meter sensitivity. See* ***Fig. 6****. Under the heading Standard Values are ways to make up the nonstandard resistors. Remember, this is a toy—not a precision instrument. Some of the composite values will work with only two resistors instead of three. Connecting a resistor, the meter, and a battery together will tell you if that is the value to use for the desired effect. Some of the values add up to a small percent less than the specified value. That will let the meter read a bit higher than the nominal 10%, 50%, etc., of full scale.*

use a taut band for the suspension. That gives even lower mechanical friction at the expense of a higher priced, more delicate instrument. A hard mechanical jolt could damage or even destroy one of these meters.

Despite the high resolution of digital meters, analog movements still find many applications. In this case, a digital meter lacks the "wiggling needle" repetitive, physical, motion wanted as one of the features of the Box. We will now look at how to add a meter to the Box, while keeping in mind its limitations. If you want to, you can add this feature later, when Junior is less likely to break it.

Colby's mother grew up around AM, FM, TV, and amateur radio transmitters and test equipment. She knew about the delicate nature of meter movements. That, combined with the type of meter used in Colby's Box, seems to have helped preserve it.

The ticking meter

A quick glance at **Fig. 6** will show a familiar sight: a flip-flop with a driver transistor, Q11. It will also show a couple of differences. The load is in the emitter of the driver transistor.

It also has some range resistors for the meter. The range resistors allow the meter to make discrete steps from zero to full scale in four steps. You could use some of the empty switch positions and have the meter step in 1, 2, 3, 4, 5, ... sequence.

With the switch in a blank position, the meter has no current flowing through it. As you step the switch through the range resistors, you change the current in preset amounts. By picking the correct resistor values, you may set the first step for 20% of full scale deflection and the second step for 50%.

By setting the last step for 100%, in this case three volts, you have a built-in battery tester. Actually, it shows how much battery voltage the switch applies to the rest of the circuit. Basically, taking a reading right after pushing the START button gives a good indication of battery condition. Of course, you may use more steps. The net effect of the step voltage readings is meter movement that seems to follow the motion of the selector switch.

By placing one side of the meter on the common line, battery minus, you can sample the switch voltage as above, or you can drive the meter with an emitter follower.

An emitter follower applies most of its input voltage to the load. The driver, Q10, sees a much higher resistance than it would if it were connected directly to the load. In this case, that resistance is about 150 times the combined resistance of the resistor R20, going from the emitter to the meter. For a 0–1 mA meter, the meter and the resistor combination would be roughly 3,000 Ω without Q11. With Q11, the second transistor in **Fig. 6**, Q10, sees about 450,000 Ω. That is much more than ten times the value of resistor R19, in series with the collector of the second transistor. That gives Q10 a good degree of isolation from the load.

The first two transistors in **Fig. 6** make a flip-flop that runs at a rather slow rate. It runs roughly from once a second to once every three to four seconds. The third transistor isolates the meter from the flip-flop. Normally, you might connect the meter to the collector of one of the first two transistors. If you did that here, you would lose the simplicity of the wiring for the step movement function. By using the follower for isolation, you can use a single, simple, rotary tap switch to get a wide variety of entertaining functions.

Matching the meter to the circuit

In **Table 1** I did the arithmetic for you, but feel free to check it. Depending upon what size meter you can get, you should find a set of resistor values to suit a meter with sensitivity ranging from 50 µA to 5 mA. These are the most commonly found meters.

Putting it all together (construction)

You may use any layout you find convenient. None of the circuits have high gain (amplification) that would cause trouble with feedback. None of them run at a high frequency which could give crosstalk (that is where two circuits couple energy or "talk" to each other). Finally, none of the circuits draws particularly high current. That says that you may do what you like with your common or ground circuits. In short, you may use a printed circuit board for the ultimate in neatness. You may use perforated board for convenience, or you may

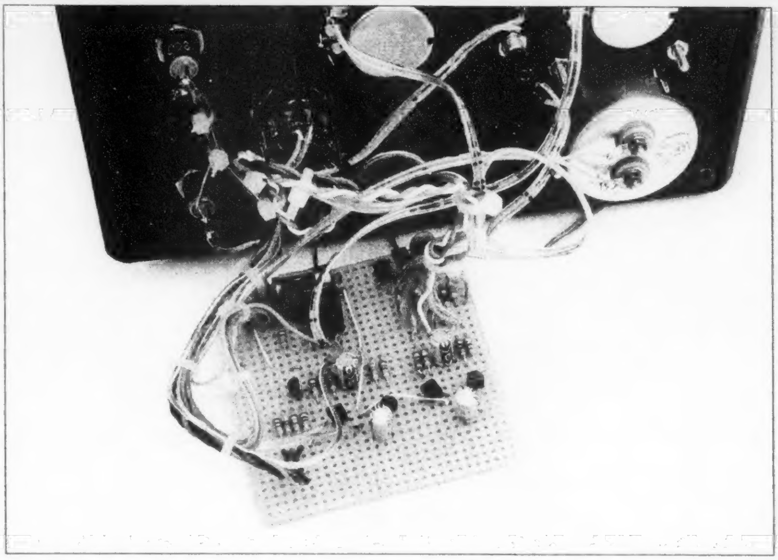

Photo A. Perfboard layout. Top of photo shows rear view of front panel. START and STOP buttons on left side. Switch 3 is near center of panel. Meter is on the right just below the control to adjust the speed of the meter ticking. The LEDs are to the left of the meter and its post. The text tells where the various sections are on the perfboard.

use no board, as I have been known to do, for speed of construction.

PC boards

You can choose to use tape to make a rough layout for each section. That way you may make just one or more of the functions. A single layout for the entire system would make it difficult to pick out just the desired function(s) if you did not want to make all of them. Simply make the boards that you want and tie them together at the indicated points, battery minus and SWITCH 3 connections.

If you plan on mass producing these items, or if you want a much more durable but less flexible finished system, use a PC layout. The other disadvantage of a PC layout is the extra time it takes. Once done, it is quite difficult to make changes to it. Despite all of that, I usually do use PC layouts—but not for a circuit that I may want to change not too long after finishing it. If this is one of your first projects, you might enjoy it more by saving the trouble of a PC layout for another time and using perforated board this time.

The perforated-board model, **Photo A**, shows this type of simple layout. Thin speaker wire makes a convenient way to connect the switches, the pots, and the circuit together. The nylon ties tidy up the wiring. Feel free to make the connections long enough to go around the same side of the board. That will let you lift the board out as needed.

Meter driver

The meter step function resistors and the meter flip-flop are in the lower left side of **Photo A**. A piece of multicolored cable connects the resistors to the FUNCTION SELECT switch. Consult **Table 1** for the resistor values. Just to make sure that those values fit your meter, connect

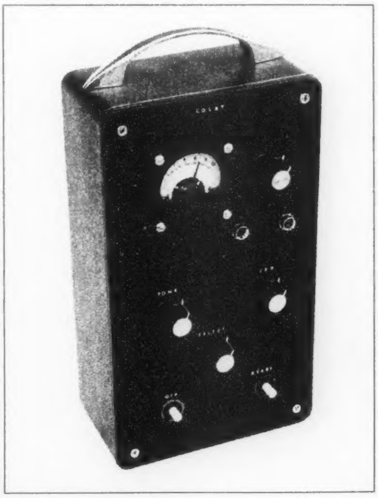

***Photo B**. The finished Box.*

one resistor, the meter and a battery, 1-1/2 or 3 volts, in series. It takes just a couple of minutes to do these suggested pre-construction tests, but it can save a lot of time if you have an undesirable value. It takes me longer to remove wrong parts from a board than it did to put them on the board in the first place.

LED driver

The LED driver circuit is on the right side of the board. Note that the transistors Q5 and Q6 are rotated 180 degrees from each other. That makes it easier to connect their emitters together. I did the same thing on the other two circuits that use a flip-flop.

You will want to pre-test the LEDs. This will tell you which lead goes to the plus side of the battery. It will also tell you if you have the right size current-limit resistor. With too small a resistor, the LED will get quite bright and probably quit working. With too large a resistor, the LED will not give off enough light.

Speaker driver

The sound generator is on the top right side of the board. The smaller capacitors in it allowed a tighter layout. After you wire it, you can test it with anything from 1-1/2 to 9 volts. The loudness and the tone will change with the voltage. When you connect the battery, if it gives just a loud click in the speaker, remove the battery and recheck the wiring. A missing or wrong value resistor or capacitor can cause that problem, as can an incorrectly connected transistor.

Auto-Off switch

The Auto-Off switch is on the back left side of the board. The complementary output stage uses TIP series transistors because they give lower voltage drop than 2N3900 series transistors in this application.

To test the switch, you can connect a battery and a voltmeter—or better yet, one of the other circuits from the Box—to the collector of Q3 and battery minus. Battery plus goes to the collector of Q1 and the *emitter* of Q3.

If you have switch 1 wired you may push it, or momentarily connect C1 and

Parts List for Fig. 3, Auto-Off Switch

Part	Description	Radio Shack Number
R1	82 k–100 k	
R2	1 k	
R3	1500–3300	
C1	22–47 µF 6 V	272-1026, 272-1027
SW1	SPST pushbutton momentary contact	275-1547 red
SW2	SPST pushbutton momentary contact	275-1556 black
SW3	Single pole 6 or more positions	275-1385A
Q1	2N3904, 2N222A or similar transistor	276-1617
Q2	TIP31 NPN or similar power transistor	276-2017
Q3	TIP32 PNP or similar power transistor	276-2027 (*or* TIP42)

Parts List for Fig. 4, LED Driver

Part	Description	Radio Shack Number
R4	50 k or 100 k potentiometer	271-1716, 271-092
R5	2700–18 k	
R6	68–82 Ω	
R7	18 k–33 k	
R8	47–56 Ω	
C2, C3	22–47 µF, 47 µF typical	272-1026, 272-1027
Q4, Q5	2N3904, 2N222A or similar transistor	276-1617
LED1	Green LED	276-069
LED2	Red LED	276-068A

Parts List for Fig. 5, Sound Generator

Part	Description	Radio Shack Number
R9	100 k potentiometer	271-092
R10	10 k	
R11, R13	4700	
R12	15 k	
R14	15 k–22 k	
C4, C5,	0.05–0.1 µF 6 V or higher voltage	272-1068, 272-1069
Q6, Q7, Q8	2N3904, 2N222A or similar transistor	276-1617
SPKR	4–32 Ω	

(PARTS LIST CONTINUES)

Parts Lists. *All lists include Radio Shack™ part numbers as a convenience. Equivalent parts will work.*

Parts for Fig. 6, Meter Driver

R15	50 k or 100 k potentiometer	
R16	33 k	
R17, R22	4700 Typical value for 0–1 mA meter	
R18	120 k	
R19, R20	1500 Typical value for 0–1 mA meter	
R21	18 k Typical value for 0–1 mA meter	
R23	2200 Typical value for 0–1 mA meter	
C6, C7	22–47 µF 6V	272-1026, 272-1027
Q9, Q10, Q11	2N3904, 2N222A or similar transistor	276-1617
METER	0–1 mA	270-1754

Miscellaneous Parts

Knobs for switches and controls	274-415
Project box	270-223
Perfboard	276-1395, 276-1394
Double-sided tape	64-2343
Rubber feet	64-2346
Battery holder(s)	270-386 (2 D), 270-401 (1 AA), 270-385 (2 C)
Handles	available at any hardware store

the base of Q1 to battery plus. A voltmeter or the other circuit connected to the Q3 collector and battery minus should show that you have voltage. After a few minutes, the voltage should start to decay, that is, it should start dropping in value. A voltmeter will follow it all the way down.

Some of the circuits from the Box will drop out somewhere under 1 to 1-1/2 volts. If you wish to speed up the action, connect a resistor or a short across C1. A 10,000 (10 k) to 100,000 (100 k) ohm resistor will give an accelerated picture of the switch action. A short across C1 should turn off the switch without delay. The OFF push-button will turn off the system with a few milliseconds' delay because of the resistor in series with the switch. If someone pushes both buttons at the same time, it would place a dead short across the battery if you left out the resistor, R3 in **Fig. 3**.

Front panel

Photo B shows the finished product for this version. I did not include a front panel layout as you may want to leave off some of the functions used in Colby's Box. Possibly, you would find another layout more to your liking even if you used all of the same features.

Wiring notes

Once you decide what you want in your Box, pick up the parts, then drill the holes for the controls, the LEDs, the switches, etc. If you do use the meter, you may want to drill the holes for it first. The battery holder goes in the bottom of the box with the help of the thick, double-sided sticky tape.

After milling and drilling, mount the controls, the LEDs, the switches and lastly, the meter. You may find it more convenient to wire the various functions on the board before connecting any of them to the front panel controls. Wiring one circuit at a time and tying it to the front panel could strain the wires and your patience if they break. With the controls mounted, you can get a close guess as to the length of the wire needed to make the connection. That will leave just one slight problem: deciding which set of wires goes to which control. A close look at the photo will show what looks like Morse code on some of the wires. I used a marking pen—you may find more conventional wire markers more convenient.

Check out time

As I completed each function, I hooked a 3 V source to it and ran it through its paces. Then I marked the wires going to the front-panel control. With several functions, the wires make a fair-sized bundle. I intended to make them long enough so that they would dress along one side of the board. That makes it easier to put the board into the box without having to fight the wire bundle.

Continued on page 40

NEVER SAY DIE

Continued from page 8

you're certainly not going to send them to a public school. Or to most private schools, either. You're going to find a Sudbury Valley-type school or take up home education.

Paying For Pre-School

Day care with education instead of baby-farming is going to cost more. It's going to be out of the question for welfare mothers, lower income families, and many single-parent families. So who's going to pay? Why should someone with no kids have to pay to educate other people's children? Perhaps we should encourage people who can't afford to pay to bring them up not to have children. While that makes sense from a practical standpoint, the idea isn't going to get much support from the religions which promote having babies, whether their people can afford them or not. So let's not try to deal with reason, let's come to grips with the religious and emotional realities. We're going to have a lot of children who need education that the parents will be unable to afford. We know that the poorest people are having the most babies, so we know the load for supporting an educational program for them is going to rest more heavily on those with fewer children.

Instead of looking at kids as parental property, let's think of them as part of our infrastructure. These kids are just that. They're the work force of the future. They're the people who will have a fundamental effect on our American quality of life in the next century. If we ignore them we'll have more poor and more crime. Crime may make great movies and TV shows, but it sure hurts when it hits you personally. It's in our own common interest to invest in their early education.

So should we get started on a massive federal program to set up day care/preschool centers? Should we invest hundreds of billions of dollars we have to borrow from Germany and Japan for this? Or should we set up state-run and financed centers? Well,

Continued on page 43

Continued from page 39

Since I have an adjustable voltage source, I could see how the various circuits worked with more than and less than normal voltage. More importantly, I could see if the circuits functioned in a more or less normal manner.

If one of the LEDs turns on and refuses to blink, look for a capacitor connected incorrectly, a misplaced resistor, wrong connections to a transistor, or the other LED hooked up backwards. These circuits are fairly simple and similar to each other. Once you get one of them working, you could copy the layout and use that for the other functions.

The sound generator is the simplest circuit, as it has no polarized parts. The capacitors in the sound generator may have either end connected to the collector, with the other end going to the base (of the other transistor). If you connect one of the electrolytic capacitors backwards in these circuits, you could get some unpredictable results. That could range from a dead circuit to the end blown out of the cap. Therefore, do pay attention to the wiring for the parts marked with a + (plus) and a - (minus) sign.

When you finish the wiring and the testing, put the batteries in their holder. With a marking pen, put the date on the batteries. That can give you a pleasant surprise the next time you have to open the Box. Then put the cover on and the screws in the cover. When you finish thoroughly "testing" all of the functions, let Junior have his or her turn at it.

Now that Junior is amusing himself with it, if you skipped the "how and why" section, you have time to go back and see what makes Colby's Do Something Box tick.

Two years after getting his Box, Colby is still entertained by it, as are his friends. If he ever outgrows it, he can use his Do Something Box as a conversation piece or a paperweight. Meanwhile, with the unit sitting on his dresser and set to the blinking LED feature, Colby can watch the lights while they slowly fade and he falls asleep thinking about his Do Something Box. 73

Number 41 on your Feedback card

EMTECH's NW40 Transceiver Kit

Another winner for QRP.

Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

Low-powered CW operation (QRP) has become increasingly more popular. Add the thrill of operating on a radio you built yourself, and it becomes easy to get hooked on this aspect of the hobby. The problem with building your own equipment comes mostly on the operating side of the venture.

It is very easy to build a simple transmitter or a simple receiver. If you find the performance of the gear you built to be poor, you will soon lose interest after the initial "high" of a contact or two. On the other hand, if you build a transceiver that can pull in the signals, is easy to operate, has a stable receiver, and provides good transmit/receive switching, you are much more likely to stay interested in QRP—and ham radio.

A number of excellent kits have become available recently at very reasonable prices. I try at every opportunity to get new ham radio operators interested in CW by encouraging them to get on the air as soon as they learn the Morse code basics. I can't think of a better way to keep interest in the code requirement than building a piece of equipment and getting on the air regularly as your method of practice.

When my son was seven years old, as soon as he learned the basic code letters, numbers, and a couple of punctuation marks, I sat with him once a night while he made a contact. It didn't take him long to bring his speed up to 13 wpm, and then to 20 wpm. He managed to pass his General license before his eighth birthday. Many hams I have talked with see the code requirement as a specific torture geared at preventing them from getting their General or above ticket. If you change the frame of reference from "I have to do this undesirable, difficult task, that I most likely will not succeed at" to "I just built this really neat little radio that I can power from a battery and talk to people all over the world with," it really does a lot to change the attitude and motivation.

After building and testing the EMTECH NW40, designed by Roy Gregson W6EMT, I would have to say it ranks at the very top of kits for either a beginning kit builder or anyone of any experience who likes to build. The kit is easy to construct and works beautifully when completed. My initial test for this radio was on Field Day 1997, which I considered trial by fire. Luckily I did not encounter any smoke-related incidents while building the kit. The rig is small and lightweight. It makes a great backpacking radio, and seems to feel very much at home in my shack. Though I have many rigs in my ham shack, I tend to use just a few regularly, and I find I use the NW40 all the time. I think I had as much fun building this kit as I am having using it.

The NW series incorporates a superhet single signal receiver with a variable bandwidth crystal filter and a two-pole active audio filter (from the *ARRL Handbook*). What this means to me is that the radio works very well at getting wanted signals heard by you even if they are weak. It also means having the ability to block out nearby unwanted signals.

The kit is available for 80, 40, 30, and 20 meters. The EMTECH NW40, not surprisingly, is for 40 meters. I have also built and tested the design on 20 meters and it worked equally well. The cabinet features painted and silk-screened front and rear panels and comes with all necessary hardware. I really like the professional look of the cabinet kit—it's lightweight but sturdy. I also appreciated not having to hunt around for all the necessary connectors. Drilling holes in cabinets has never been one of my best skills.

The radio tunes more than the advertised 7.000–7.2000. This is a great feature for a Novice operator. You can build the kit, operate on the Novice portion of 40 meters, or listen to SSB. As you upgrade your license, you will already

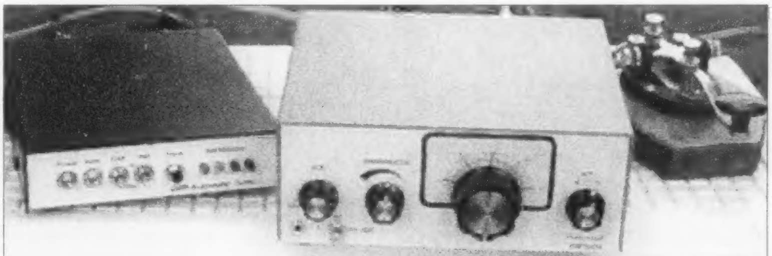

***Photo A.** The EMTECH NW40 joins an LDG QRP autotuner for Field Day 1997.*

have the ability to work that portion of the band.

I also found the receiver to work exceptionally well. I haven't found any drift problems. I really like the tone of the radio and it will drive a five-inch speaker. There's a front panel adjustment for volume. I don't turn up the audio level much. Many kits have front panel RF control but I have usually found that once I set the RF level, I almost never touch the control again—but I sometimes wish that the radio had a volume control. I was pleased to see this feature incorporated in the NW40 kit design. The radio has receive incremental tuning (RIT). This is another useful operating feature, especially in noisy or crowded band conditions.

The NW40 has solid-state true QSK. This means that you can hear signals between your dits and dahs even at 20 wpm, just as with the expensive commercial rigs. The sidetone is derived from the transmitted signal. You can adjust the level to suit your preferences with a simple internal adjustment. I found the switching to be smooth, without any clicks or other annoying features. My rig initially put out a little over seven watts, but it is internally adjustable to the mW range. I operate mine a little shy of five watts, to stay in the QRP range classification.

Building the kit

The NW series are first-line kits. The parts are all good quality. The printed circuit board (PCB) is one of the nicest I have ever worked on. It has excellent silk-screening and plenty of room on the board, making correct parts placement a lot easier. The silk-screen even has clear markings for the legs of the transistors (C-B-E, D-G-S), which is very helpful for checking voltages and locating problems. The bottom side of the board is solder-masked to help prevent the leading cause of kit-building problems: solder bridges.

Photo B. Avery Ashby KE4ERW, member of the Tennessee Technological and Amateur Radio Society, gets ready for a contact.

One of the aspects I appreciated most about the kit was that you build a section at a time and then test it. I find that this approach maximizes the probability that you will be successful. I think beginning builders will find this especially helpful. To help even further in making building this rig a truly enjoyable experience, the parts for each section are packaged separately.

The part I like least about building kits occurs before I start soldering. This is separating out and labeling the parts. With each section individually packaged, I found I could dump the parts in a small plastic container and then easily pick out the parts as I needed them. The only exception to this is the "band pack," which has those components needed to build the kit for each of the bands.

To build the kit, you will need a 15–30 watt soldering iron. I suggest having some desoldering braid around. If you put a part in the wrong spot on the board, this will make it very easy to remove the part without damaging the board or the component. To align and test the kit you will need minimal test equipment, a VOM, and a calibrated station receiver or transceiver. It is helpful to have a frequency counter, wattmeter, and oscilloscope, but they aren't essential.

The manual is great—clear explanations of component markings that make it easy to identify them, detailed drawings for component identification, and blowups for each section you build. The blowups are very helpful. There are also enlarged diagrams for the final wiring sections. I really appreciated the two-page section in the manual that gave resistances and voltages for the transistors and ICs. I found the directions to be complete and easy to follow. I had *no* surprises caused by the manual.

The first steps for building the kit tell you how to wind the toroids. Some beginning builders get nervous when they first encounter this. The directions will lead you through the steps and you shouldn't have any problems. Make sure while building that you highlight the band you are working with so that you wind the coils for the correct one.

Also, be careful in checking the "Band Table" below to ensure that you handle the transformers properly.

Tuning Ranges	
80 meters	3.500–3.750
40 meters	7.000–7.200
30 meters	10.100–10.135
20 meters	14.000–14.070

For 20 and 30 meters you will be required to break a small internal capacitor on the bottom of the transformer. I highlighted the information for the band I was building and read the information twice before proceeding.

After winding the toroidal coil, you will build and check the VFO. You next build and check the keying circuit, the RIT circuit, the audio amplifier, and then the receiver.

Each section is fairly compact and doesn't require too many parts. This is helpful for the beginner as well as the experienced builder. It divides the project up into easily managed sections and gives the builder a feeling of accomplishment. At this point, you build the optional meter circuit. The parts are included with the kit (I chose not to build it).

You next proceed to the transmitter section and then test it without the final transistor in place. Once you are confident that the transmitter is working correctly, you add the final transistor.

The final adjustments involve setting the BFO, centering the RIT, and setting the VFO range. Once this is accomplished, you set the transmitter level and adjust the sidetone. I found the adjustments to be very straightforward and easy to do. If you have a problem there is a page on troubleshooting as well as the two pages on voltages and resistances.

The audio filter (AF1) is a very small board with a low parts count (17). You can select the filter bandwidth by selecting pairs of resistors. Resistors for each bandwidth are provided. The two bandwidths are 750 Hz and 650 Hz. There is also a set of resistors for changing the audio gain. I used the suggested values and am very pleased with the results.

On the 20-meter version, I experimented with all the values. I suggest using the recommended values. Once you have completely checked out the operation of the rig, go ahead and experiment.

The bottom line is that this was one of the most fun kits I have had the pleasure

to build. The care EMTECH took in planning the instructions and the parts packaging really made it enjoyable.

Operating the NW40

After I assembled and aligned the rig, and long before it found its new home in a stylish case, I was impressed with the receiver. Sitting before the wooden table of my workbench, I powered up the rig on it. This was one of the few times I have not been anxious about smoking parts. Since I had tested each section as I built, I was confident that the worst problems I might encounter would be small. On power-up with no antenna, I was still pulling in signal fairly clearly. I wrapped the board with all the controls hanging off it and brought it over to the operating bench, connected my antenna and hooked up a battery. The band was pretty noisy so I turned on the audio filter. The filter does a great job in cutting out band noise. I tuned around and heard WQ4L. I was able to work John in Mount Vernon VA. I then worked Arn KK4VH, in Portsmouth VA.

I needed to leave the project for a while. The day before Field Day I got the rig in the case and it was ready to go. No time for further testing before the big day. For Field Day I hooked up a G5RV between two trees up at about 25 feet. I hooked the NW40 to my little LDG autotuner and a 4 Ah gel cell and my straight key (last used during my Novice days).

I had no problem working most contacts, except if there were many stations all on the same frequency. The receiver was able to stand up to the crowded band, and with the bandwidth set at about the middle position I found that the rig really held its own. We worked over 200 contacts with the little gem with only a couple of operators and not much operating time on the air. We blew away the remaining club workers who were operating SSB using a commercial 100 watt rig and resonant dipoles. Obviously, the NW40 is a quality transceiver and you can expect to get plenty of use out of it if you build it properly.

For $130, including the audio filter, case kit, and shipping, you get a quality radio that is fun to both build and operate. For further information, contact EMTECH, 3641A Preble St., Bremerton WA 98312; (360) 415-0804.

NEVER SAY DIE

Continued from page 40

we know that public schools tend to cost at least twice as much to run as private schools, so let's not consider federal or state-run institutions. I'm suggesting the use of state-collected money to pay for private centers. The old voucher system.

But who's going to control these centers? Don't we need state accreditation, complete with more state inspectors and administrators? Absolutely not! This is a big part of the problem we have today, and certainly is not a part of the solution. I would go along with the state setting up an information service, complete with a newsletter for parents. This group would inspect the centers and report on them. From there on it'd be up to the parents to take action.

If I were doing it I'd make the whole operation self-funding by charging for advertising in the newsletter, plus charge nominally for subscriptions. Parents unable to afford say $10 a year for a newsletter could read it in their local libraries. What advertisers? How about the makers of educational toys? How about the publishers of children's books? Children's videos and cassettes? Children's clothes? The revenues from these firms should easily support investigative teams to visit centers and report on them, plus get input from the parents who take the time to help the day-care centers.

Are you critical of me for thinking in terms of publications to help solve problems? Publications happen to be one of the best ways of distributing information.

I tend to think in entrepreneurial terms—of making publications at least not lose money. I believe in the fundamentals of capitalism. I believe in making our state governments as capitalistic as we can instead of trying to run them on the socialistic system, which has failed in every country where it's been tried. So I tend to want to privatize as much of our federal, state and local government activities as possible. They'll cost us the least that way and we'll tend to get far better service.

I admit that the capitalistic system is not working well with Congress. Gore Vidal isn't completely wrong in his estimation that the international megacorporations and big unions with their lobbies have bought our government. This situation could be improved with a publication which would expose which members of Congress have gotten money from which lobbyists, and what legislation has resulted. If we had a publication which informed the public, the media, and potential candidates on these matters, it might act as a deterrent.

I remember when *US News* did an exposé on Senator Bentsen, showing what payoffs he'd gotten in return for tax breaks for large corporations. The formula seemed to be about one dollar in his kitty for every thousand in tax breaks he was able to put through for these special interests. Just the kind of guy we needed for vice president, right?

The information is public, if you fight hard enough to get it. So let's throw the light

Continued on page 45

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the February 1998 issue, we should receive it by November 30. Provide a clear, concise summary of the essential details about your Special Event.

NOV 1

ENID, OK The Enid Hamfest Group will sponsor the Enid Hamfest, 8 a.m.–5 p.m. at the Garfield County Fairgrounds (Hoover Bldg.), at Oxford & 4th Streets. Adm. $2; tables $1 each. VE Exams at 1 p.m. Free covered dish banquet at 7 p.m. Contact *Tom Worth N5LWT, (405) 233-8473* or *Fred Selfridge N5QJX, (405) 242-3551*. Talk-in on 147.15(+) and 444.40(+).

MILWAUKEE, WI The Milwaukee Repeater Club will sponsor the 13th annual "6.91 Friendly Fest" 8 a.m.–1 p.m. at the Waukesha County Expo Center Arena Forum, N1 W24848 Northview Rd., in Waukesha WI. Setup at 5:30 a.m. Tickets $5; 4' tables $5. Please call *Burt N9VBI, (414) 328-0535*. Send SASE with payment to *The Milwaukee Repeater Club, P.O. Box 2123, Milwaukee WI 53201. Web [http://www.execpc.com/~mrc/friendlyfest.htm]*. On-site VE exams. Talk-in on 146.91(-) (The Friendly Repeater), and on 146.52.

WATERFORD, CT The Tri-City ARC of Groton CT will host its 7th annual Fall Auction at the Senior Citizens Center, Waterford Municipal Complex (Rt. 85, south of Exit 77 of I-395, or north of Exit 82 of I-95). Setup starts at 9 a.m. The auction will be held from 10 a.m. until sold out. Adm. is free and food will be available. Wheelchair access. Bring your equipment to be auctioned. Talk-in on 146.37/.97 rptr. For more info call *KA1BB at (860) 739-8016*.

NOV 2

KAUKAUNA, WI The Fox Cities ARC annual Hamfest will be held at the Starlite Club, corners of Hwy 55 and Cty. Road 11. Advance tickets $4 each, 8' tables $8 each. You must buy an adm. ticket if you pre-register. Send check or money order payable to *FCARC, 1912 Russet Ct., Appleton WI 54914; Attn: Chad Pennings N9PRC, Hamfest Chairman; Tel. (414) 993-0485*. Talk-in on 146.52 simplex. Register for VE exams at 8 a.m.; testing starts at 9 a.m. No walk-ins after 9 a.m. Bring original license plus 2 copies, and a photo ID. For more exam info, contact *Larry Siebers KD9IA, (414) 757-1167*. Nearby lodging.

NOV 8

MONTGOMERY, AL The Montgomery ARC will host the 1997 Alabama ARRL State Convention and the 20th annual Montgomery Hamfest and Computer Show in Garrett Coliseum at the South Alabama State Fair grounds located on Federal Drive in the NE section of historic Montgomery. Adm. $5, free parking, all indoors including the flea market. Setup 3 p.m.–8 p.m. Fri., Nov. 7th; and 6 a.m.–7:30 a.m., Sat., Nov. 8th. Doors open to the public 8 a.m.–5 p.m. CST. VE exams on site beginning at 8 a.m. Bring original and a copy of your current license, picture ID and $3. Talk-in on 146.24/.84, call W4AP. Rag-chew 146.32/.92 (with phone patch, *up/#down), 147.78/.18, and 449.50/444.50. Flea market reservations are encouraged. Kickoff banquet Fri. evening at Bonnie Crest Country Club, with ARRL national staffer Rick Palm K1CE. Contact *Patty at (334) 567-7195*, or *E-mail to [prolan@juno.com]* for reservations. ARRL QSL card verification for all awards (WAS, DXCC, etc.) on site. For more info or table reservations, write to *Hamfest Committee, c/o 2141 Edinburgh Dr., Montgomery AL 36116-1313;* or phone *Phil at (334) 272-7980 after 5 p.m. Fax (334) 365-0558;* or E-Mail *[WB4OZN@worldnet.att.net]*.

NOV 15–16

FORT WAYNE, IN The Fort Wayne Hamfest & Computer Expo (including the Indiana ARRL Convention), sponsored by the Allen County Amateur Radio Technical Soc., will be held at the Allen County War Memorial Coliseum and Exposition Center, at the corner of Indiana 930 (Coliseum Blvd.) and Parnell Ave. Doors open for dealer setup Fri. eve. and Sat. morning. Open to the public 9 a.m.–4 p.m. on Sat, and 9 a.m.–3 p.m. on Sun. Features include: Flea market, new and used radios, computer and general electronics, forums, meetings; with VE exams on Sat. Coliseum parking is $2 per vehicle. Adm. $5 (children under 12 free with an adult). No advance ticket sales. Talk-in on 146.88(-). Tables are available for $15 each (flea market) and $30 (premium). Electricity $25 per vendor. To order tables or request info, send an SASE to *ACARTS, P.O. Box 10342, Fort Wayne IN 46851*. For general info, call *Doug Jones, (219) 484-1314;* or for table info call *Bill Anders, (219) 483-8163*.

NOV 21 – 22

OCEAN SPRINGS, MS The West Jackson County ARC will hold its annual Hamfest/Swapfest at the Latimer Community Center north of Ocean Springs. The hamfest will be open to the general public 4:30 p.m.–9 p.m. on the 21st; and 8 a.m.–3 p.m. on the 22nd. Adm. is $2 per adult, or $4 for an entire family. The Latimer Community Center is located approx. 4 miles north of I-10 exit 50. Ample parking is available at the Community Center. Completely self-contained RVs may park overnight. There are several motels in the vicinity of Exit 50. 8' sales/swap tables $5 each. Advance deposits are required for sales table reservations. Talk-in on 145.110 MHz (-600). The frequency will be manned from 12 noon on the 21st until the hamfest ends on the 22nd. Contact *Harry McLemore KD4AK, (601) 872-0732*, or *Stan Hecker N5SP, (601) 875-0222*. Send written correspondence regarding the hamfest to *West Jackson County ARC, Inc., P.O. Box 1822, Ocean Springs MS 39564*.

NOV 22

NEWTONVILLE, MA The Waltham ARA and the 1200 Radio Club will co-sponsor an Amateur Radio and Electronics Auction, 11 a.m.–4 p.m. at Newton Masonic Hall, 2nd floor, 460 Newtonville Ave., at the corner of Walnut St., in Newtonville MA. Adm. $2. Free parking in the municipal lot across Walnut St. Please do not park in the lot next to the Masonic Hall, nor in the Star Market parking lot. If you are selling, please label your equip. with a brief description and state its condition. Include your call and name on the label. Bag small items. Don't bring junk (TVs, boat anchors, non-electronic items, etc.) Commission 15%; $1 minimum; $30 maximum; $0 for owner buy-back. For more info, contact *Eliot Mayer W1MJ* at *(508) 664-0773; E-mail [w1mj@amsat.org]*. Check the auction Web page at *[http://ourworld.compuserve.com/homepages/emayer/auction.htm]*. Talk-in on the 146.64(-) Waltham rptr. WARA and 1200 RC thank the Newton Masonic Associates for the use of their fine facility.

DEC 7

HAZEL PARK, MI The Hazel Park ARC will hold their 32nd annual Swap and Shop 8 a.m.–2 p.m., at Hazel Park High School, 23400 Hughes St., Hazel Park MI. General adm. $5 advance or at the door. Tables $14 each. Reservations must be received with check, no reservations by phone. Plenty of free parking. Talk-in on 146.64(-) (DART). Swap info, tables, and ticket reservations to *HPARC, Box 368, Hazel Park MI 48030*.

JAN 17

ST. JOSEPH, MO The 8th annual Northwest Missouri Winter Hamfest will be held on Jan 17th, 1998, 9 a.m.–4 p.m. at the Ramada Inn in St. Joseph MO, with special room rates for Hamfest participants. The event is being co-sponsored by the Missouri Valley ARC, Green-Hills ARC and Ray-Clay ARC. The motel is located at I-29 and Frederick Ave. (exit 47 on I-29). Talk-in on 146.85 and 444.925. VE exams, major exhibitors and flea market all indoors. Free parking. Advance tickets $2 ea. or 3/$5; at the door $3 ea. or 2/$5. Pre-reg. requests received after Jan. 8th will be held at the door. Swap tables $9 ea. first 2 tables. Commercial exhibitors welcome. Write for details to *Northwest Missouri Winter Hamfest, c/o Gaylen Pearson WBØW, 1210 Midyett Road, St. Joseph MO 64506*.

SPECIAL EVENT STATIONS

OCT 28–NOV 2

ST. CHARLES, IL Unity Lodge #48 AF & AM of St. Charles, IL will operate N9FWM 0100 UTC Oct. 28th–2300 UTC Nov. 2nd, to celebrate their 150th year. N9FWM will operate SSB alternately on 28.400, 14.250, 7.150 and 3.980.

For a certificate, send QSL and a 9" x 12" SASE for unfolded or #10 SASE for folded, to *N9FWM, 38W248 Joan Dr., St. Charles IL 60175 USA.*

OCT 31–NOV 1

BREVARD, NC The Translyvania County ARC (KE4ZIS) will sponsor their 9th annual "Halloween Fest" at the Devil's Courthouse, located on the famous Blue Ridge Parkway in Brevard. The station will be on the air 1800 GMT Oct. 31st–0200 GMT Nov. 1st. Frequencies: 7.237, 14.295, 21.305, 28.335, 146.25 MHz (+/- 10 kHz for QRM). Certificate available with large SASE to *TCARC, P.O. Box 643, Brevard NC 28712 USA.*

NOV 4–11

GUELPH, ONTARIO, CANADA The Guelph ARC will operate VG3W from the birthplace of Col. John McCrea, WWI surgeon and poet, author of *In Flanders Fields.* Local school children may use the station to send messages of peace and goodwill. Operation will be from 1400Z–2100Z Nov. 4th to Nov. 11th, on 80 meters and 6 meters. For a QSL, send QSL and SASE to *Scott W. Smith, 296 Elizabeth St., Guelph, ON, Canada N1E 2X7.*

DEC 12–13

BETHLEHEM, IN The Clark County ARC will operate W9WWI, 1500Z Dec. 12th–2200Z Dec. 13th in celebration of the Christmas Season. Operation will be on General 75, 40 and 20 meters. QSL with an SASE for a certificate, to *CCARC, 1805 E. 8th St., Jeffersonville IN 47130 USA.*

JAN 10–11

1998 HUNTING LIONS IN THE AIR CONTEST The 26th annual Hunting Lions in the Air Contest will take place 0900 UTC Sat., Jan. 10th–2100 UTC Sun., Jan. 11th, with the objective to create and foster a spirit of international understanding and cooperation among amateurs and Lions, through worldwide communication. The contest is to commemorate the birthday of the founder of Lionism, Melvin Jones, born at Ft. Thomas AZ, USA, on Jan. 13th, 1879. Operators interested in additional info regarding this contest should write to *Contest Committee, Lions Club Flen, Box 106, 642 23 Flen, Sweden. E-mail [goran.blumentahl@swipnet.se].*

NEVER SAY DIE
Continued from page 43

of day on these things. I can't think of any advertisers for such a publication, but I'll bet it could easily make a profit just on subscriptions. A couple thousand newspapers would want it, plus who knows how many potential Congressmen interested in upsetting incumbents. It should sell well.

It would be interesting to show how much foolish legislation Waxman (Hollywood) has introduced to support the movie and record industries' giant corporations. And also how much Gore (Nashville), while a senator, proposed for the record industry. As the Washington insiders keep telling us, it's so much worse than you think, that you can't even imagine how bad it is. Having been deeply involved with the record industry, I had a first hand opportunity to watch the sleazy work done by Waxman and Gore. Yes, I was down there in Washington, testifying fruitlessly before Congressional hearings.

The bottom line is that I propose we plan to pay for pre-school education by having our states collect the money and make it available in voucher form for parents. If we manage to keep the state and federal governments out of running or controlling the schools we'll keep our costs to a minimum. I'd like to see the states organize a profit-making information publication for parents as the controlling system.

How we should collect the money for this is another story. I have some ideas on this, but this isn't the best place to go into the details. That's a whole 'nother story in itself. Do we want an income tax, property taxes, sales taxes, or what? Each has pluses and minuses. And since most tax approaches have aims other than just plain revenue collecting, that'll be an interesting subject to discuss.

Mea Culpa

I hope the above will help some of you. Oh, how I wish I'd known about all this before I had my children. They could have turned out a lot different. Alas, becoming a parent is both fun and easy, with no knowledge or licensing required. Our schools don't teach our kids about having kids, and finding the right books is very difficult. Please
Continued on page 70

A Baycom-Style HF PSK Modem

Build a packet modem from scratch.

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PSK packet? What the hell is PSK packet, you might ask? Well, for a start, PSK stands for Phase Shift Keying. PSK has quite a lot going for it, especially when you want to run high-speed traffic on a reliable path. 1200 baud on HF isn't a problem at all. Faster baud rates are quite possible.

Our first introduction to PSK packet came about when the QDG (Queensland Digital Group) asked us to consider setting up a PSK link to VK7 as a message forward station. As VK4WIG BBS had been set up as a club BBS within our club rooms, it was thought that we would be able to draw upon our resources to make the link a going thing.

A subcommittee was formed to investigate the possibility of such a setup. A crystal-locked transceiver was lent to the club by Ed VK4JEN for our tests on 14 MHz. A TNC, modified for PSK use, was sent down from QDG for our test.

OK, what have we got? we asked ourselves. Not knowing a thing about PSK packet we had a lot of questions to ask. The thing that stood out the most was the fact that not too many others really understood PSK either. We were faced with a steep learning curve, to say the least! Then along came Doug VK4ZDR. He had been instrumental in setting up the PSK radio links for NASA during the '60s and '70s, and he is a member of our club. He is also a co-sysop for our BBS VK4WIG.

Our resources had grown at a great rate. All we had to do was put it together—when it all went sour. We did put the setup together after we were able to find out what frequency to set the rig on. Peter VK4XPD got hold of a crystal that would let us work the frequency and tune the rig to it. The commands for the TNC were finally sorted out, and after a couple of weeks we finally connected to VK7BBS. We thought we had it made. A few more tests were done and then disaster … the TNC died!

What to do now? we asked ourselves. We didn't have another TNC modified for PSK use. What do we have to do to modify another TNC? Then we came across the G3RUH design for a PSK modem used for satellite use in conjunction with a TNC, which turns out to be the basic setup in the TNC we had. A copy of the G3RUH modem setup was given to all concerned to evaluate whether we could use it with any other TNC. Our options were diminishing at this stage.

As VK4WIG was running with Baycom-style modems at the time, we considered that there wasn't a great need to persist with a TNC-based PSK setup. Now we had our work to do, to design a Baycom-style PSK modem that would run into an FBB-based BBS along with the other modems already in use.

The basic concept for the design revolved around the G3RUH design, but utilizing the principles as if it were a Baycom modem feeding the computer. The original design simply replaced the TCM3105 chip pins as in a Baycom modem setup. A PCB was laid out to include the basic G3RUH design for his terrestrial use and feed into a Baycom board. Initial tests were done on 2m between our two local stations, VK4AOC and VK4TN. After we sorted out the filter restrictions that the rigs imposed upon us, it worked out well.

The next step took a while to finalize. As we had found out quite a while ago,

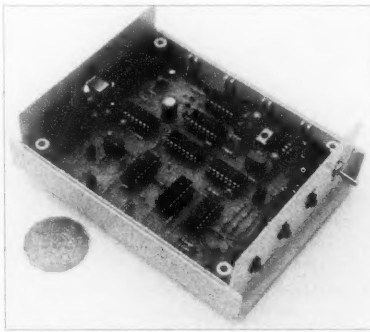

Photo A. *Top view shows handy size of PSK Modem.*

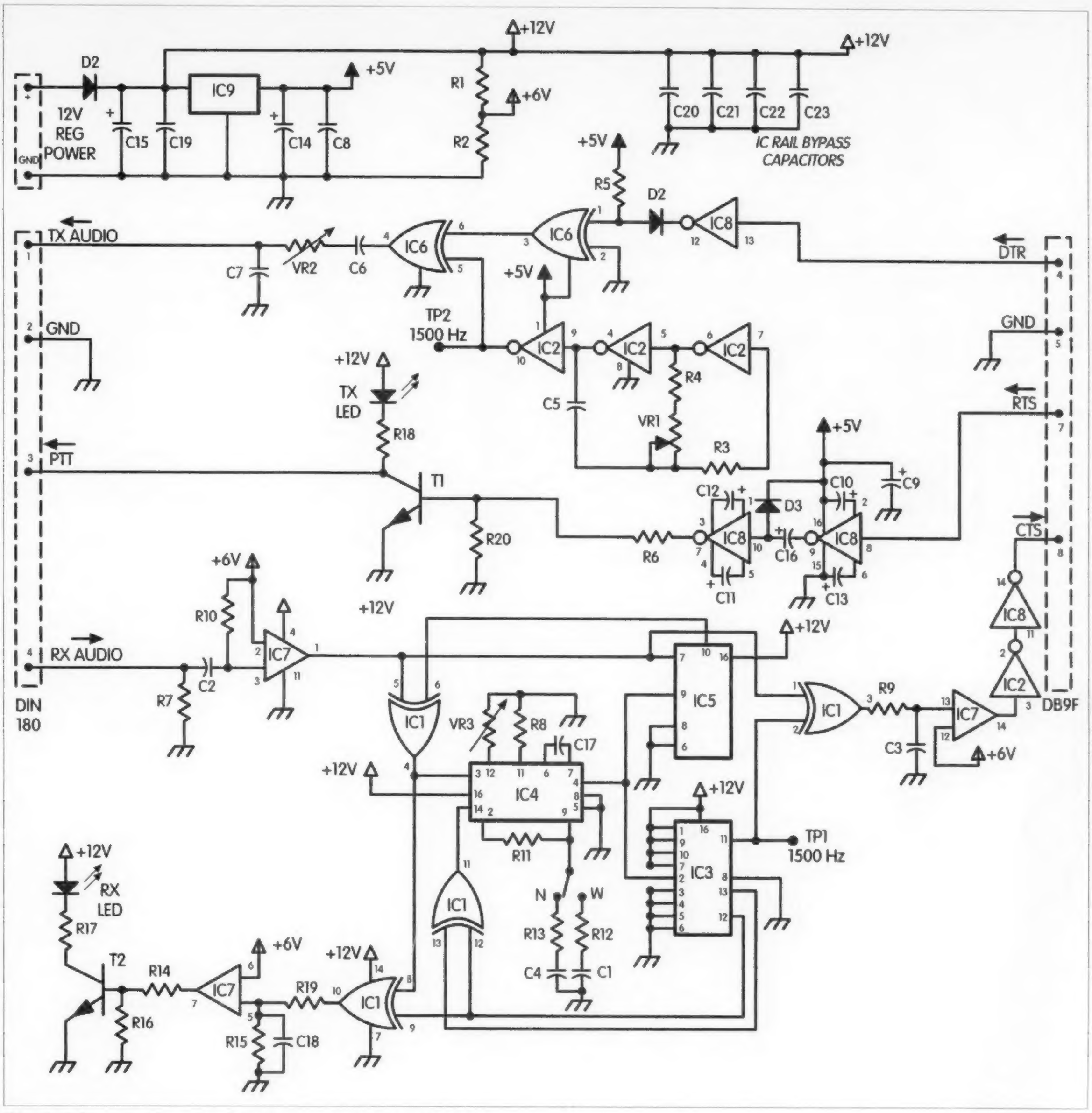

Fig. 1. Schematic diagram of the Baycom-style HF PSK Modem.

the original Baycom modem fed the computer via a 74HC04 chip, which meant a pseudo RS-232 level was presented to the serial port. This caused problems with reliable operation. We are at present driving our serial port via MAX232 chips which deliver a standard RS-232 level—no more problems!

The next problem to overcome was to provide a stable 1500 Hz TTL level signal to feed the TX modulator as described in G3RUH's article. He had suggested that a frequency somewhere between 1400 Hz and 1600 Hz would do the job. Our selection seemed to work out quite well, but it drifted. That problem was solved by the introduction of a low-drift capacitor in the circuit. A .01 μF J polyester with a 120 ppm/deg C was our choice. All our tests on the oscillator have shown a high degree of stability, running weeks at a time with a 1 Hz drift.

We also required a timeout circuit to be incorporated with the design and the two spare inverters within the MAX232 were pressed into operation for that. TX and RX LEDs were also required. The TX LED wasn't a problem at all, but the RX LED required a bit of thought. It finally turned out to be the "Lock" indicator LED in G3RUH's setup.

A prototype PCB was laid out and built. Tests carried out provided instant success with connections to VK7, VK2, VK5 *and* VK4 stations.

Circuit description

The circuit can be broken down into five parts consisting of:

1. The TX modulator.
2. The RX demodulator.
3. The timeout and PTT circuit.
4. The RX LED circuit.
5. The power supply.

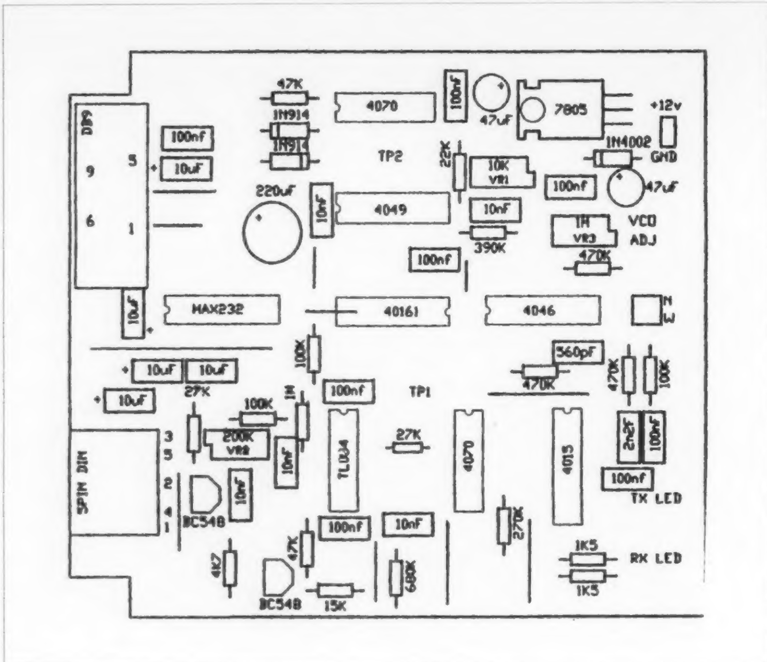

Fig. 2. Parts placement diagram for the PSK modem.

TX modulator

The data from the computer is fed to a MAX232 gate which inverts and sets an RS-232 level in case of long leads. This in turn is fed to the 4070 exclusive-ORed gate. The output of that gate feeds another 4070 gate which is also fed by our 1500 Hz oscillator. The output of this gate is the result of our combination and is coupled to the audio input of the radio. What we have as a result is PSK-modulated audio. The level of audio is set with VR2 and the 1500 Hz is set via VR1 and tested on TP2. Please note that C5 is a high-stability-type polyester, e.g.,"J" (120 ppm/deg. C.) or better.

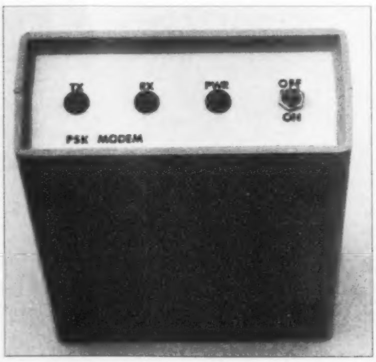

Photo B. Front panel view.

RX demodulator

Apart from our inclusion of a MAX232 gate, this is part of the circuit that G3RUH described for his JAS-1 satellite modem. It's extremely easy to set up—all you have to do is adjust VR3 to obtain a 1500 Hz signal on TP1. You can choose two bandwidth settings, 20 Hz and 100 Hz. We have found 100 Hz to be the best so far. Please note that C17 should be a polystyrene.

Timeout and PTT circuit

Because we wanted to include a TX timeout circuit, we had to decide which chip to use. Because of board location, the MAX232 spare gates won the job. C16 and the internal pull-up resistor in the gate set the timeout to approximately 22 seconds. A simple NPN transistor is used to switch our PTT line LOW as well as drive an LED as the TX indicator.

RX LED circuit

This part of the project was once again described in G3RUH's satellite modem, but as a lock indicator. The only thing that has changed is the value of R15 from a 750 k to a 680 k. It gave a better indication of LOCK when using this modem on HF.

Parts List

A1	5 pin DIN
A2	DB 9/F
A3	IDC2 2-way header pin
A4	IDC4 4-way header pin
C1	.0022 µF Mylar™ or polyester
C2, C3, C6, C7	.01 µF Mylar or polyester
C4, C8	.10 µF Mylar or polyester
C5	.01 µF J polyester
C9–C13	10 µF tantalum
C14, C15	47 µF electrolytic
C16	220 µF electrolytic
C17	560 pF polystyrene
C18–C23	.10 µF monolithic or disc ceramic
D1	1N4002
D2, D3	1N914
IC1, IC6	4070
IC2	4049
IC3	40161
IC4	4046
IC5	4015
IC7	TL084
IC8	MAX232
IC9	7805
R1, R2, R13	100 k
R3	390 k
R4	22 k
R5, R14	47 k
R6, R9	27 k
R7	4.7 k
R8, R11, R12	470 k

(Parts List Continues)

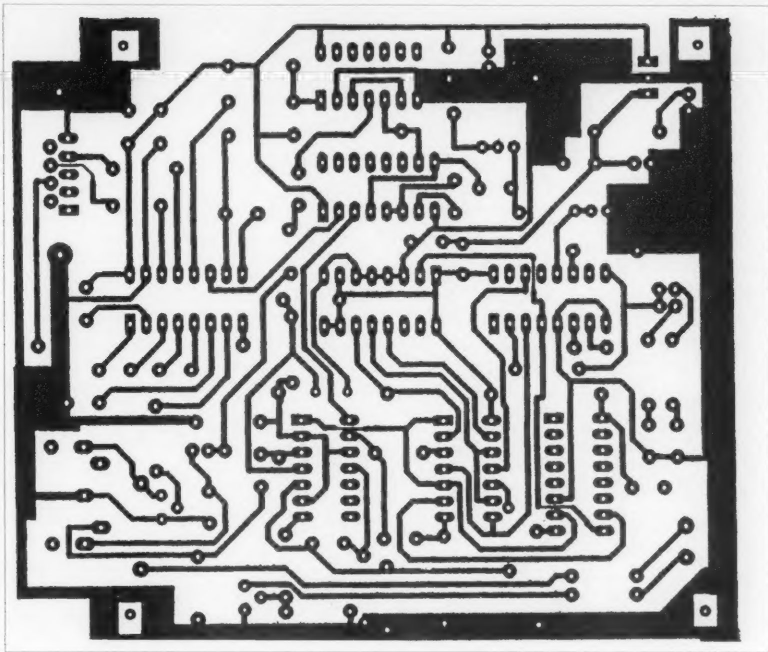

Fig. 3. PSK Modem circuit board layout, component side view.

First, set TP2 to 1500 Hz by adjusting VR1. Next, set TP1 to 1500 Hz by adjusting VR3. VR2 is set about halfway for the TX audio input and can be adjusted to suit the rig being used. The RX audio input can be fed straight out of any SSB transceiver extension speaker output. Tune in to a PSK station until you see the RX LED on the modem light. You may find that on some transceivers the signal has to be fairly strong before you resolve anything at all. It is possible that the audio filters after the product detector are causing the problem. In that case, a simple tap-off prior to the product detector with a small amp may be in order. Most commercial rigs used for data do this. I am using a Yaesu FT-102 at my QTH on 14 MHz with a tap-off from the product detector to an external jack. Austen (Ausie) VK4TN uses a TS- 520S with an external speaker jack as his RX audio source.

Power supply

12 VDC is used to feed the modem, but we did have to provide 5 VDC and 6 VDC as well. A three-terminal 5 V regulator has been employed, along with a simple resistor divider to obtain the 6 V line. Total current consumption is well under 100 mA.

Parts List (continued)	
R10	1 M
R15	680 k
R16	15 k
R17, R18	1.5 k
R19	270 k
R20	15 k
T1, T2	BC548
VR1	10 k multiturn
VR2	200 k multiturn
VR3	1 M multiturn
All resistors 1/4 W	

Table 1. Total components = 64.

Please note that a well-regulated supply should be used.

Construction

To keep the project as neat as possible, the whole unit has been laid out on a PCB to fit in a standard kit-size box available at most electronic stores. The only components not mounted on the PCB are the LEDs, power input socket, and an ON/OFF switch. We decided to use IC sockets in our first unit, but they aren't necessary if you wish to omit them. They can save you a few problems, though, if you happen to have done something wrong when loading the board!

Remember to check your voltages around the board first before loading the ICs. Double-check the IC layout (e.g., location of pins). Make sure you use a high-stability cap for C5 in the 1500 Hz oscillator. The higher the stability, the better. Use multiturn pots to make the setup dead easy and save a few follicles from hitting the floor. Also remember to put the jumpers onto the board *first*. There is one jumper required to go under the 40161 which can be missed out.

Alignment

You will need access to a frequency counter for the setup of the modem.

Comments

This project has been a challenge to all of us here at the Gold Coast Radio Club involved in packet and general RF techniques. One thing that has stood out during the development of the project has been the spirit of amateur radio, and the helpfulness of the members that were interested. We personally would like to give credit to those who participated in the project. Thanks, guys!

PC boards for the HF PSK Modem are available at a cost of $45 AUS or $36 US. The boards are professionally made and of a high quality. Postage is included for Australia; add $5 AUS or $4 US for overseas. All inquiries should be sent to: Gold Coast Amateur Radio Society, Inc., P.O. Box 588, Southport, QLD 4215, Australia.

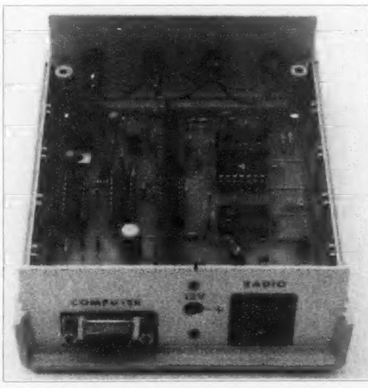

Photo C. Rear view shows external connections.

CARR'S CORNER

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Builder's potpourri

One of my passions for many, many years has been building electronics projects. Although I have several types of circuit modeling software that allows me to scope things out before going to the bench, I still like to do a little experimenting ("cut 'n' try") on the workbench. Of course, the software allows me to get closer to the goal, but I still like to heat up the old soldering iron. This month, let's take a look at some issues that affect amateur electronic and radio constructors ... especially those who do radio frequency (RF) projects.

Mounting printed circuit boards

Most projects today are built on either perforated circuit board (perfboard) or printed circuit boards (let's call both "PCB"). For most projects I use #4-40 sized screws to hold the PCB to the chassis. For larger boards, or where heavy components are mounted on the board, it may be wise to use #6-32 hardware. Or alternatively, if your project is ultra-miniaturized, try using #2-36 (my eyes don't allow that one).

If you've ever tried to get a #4 or #6 hex nut onto its machine screw, you will understand why I think one of the great product designs of all time is the little red "nut starters" that Heathkit supplied with their kits. They held a #4 nut on one end, and a #6 on the other end. If anyone knows a source for these tools, please contact me (see "Connections").

Fig. 1 shows a method for mounting PCBs to a chassis. Short #4 machine screws are used to hold the PCB, and these are held fast by threaded standoffs (also called "spacers"). These components come in both metal and insulated forms, as well as threaded and non-threaded. The reason that a short machine screw is needed is to prevent taking up too much space inside the standoff, so that the machine screw that is inside the rubber foot can be accommodated.

Whether you select metal or insulated standoffs depends on the application, and whether you want to carry the ground connection through the standoff. I personally believe that is a poor practice, and in all of my projects I supply a separate ground connection. This connection is usually made at either the signal connector ground lug, the DC power supply ground lug, or a separate ground lug attached to the chassis.

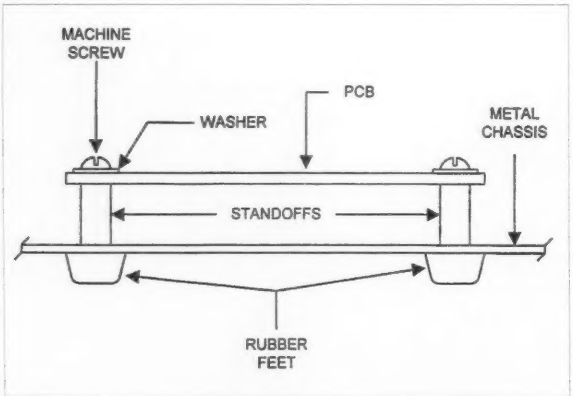

Fig. 1. Mounting a PCB with rubber feet on the chassis.

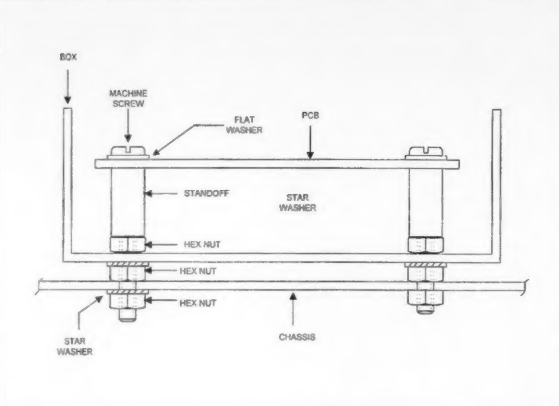

Fig. 2. Mounting a shielded box and PCB to chassis.

Fig. 2 shows a slightly different situation. In this case, the PCB is mounted inside a shielded box or enclosure, which is in turn mounted to a chassis. If you don't use a threaded standoff, then fasten the standoff together with the PCB using a separate hex nut. Pass the threaded end of the machine screw through the box, and fasten another hex nut and star washer. Finally, pass the machine screw through the chassis, using a second star washer and hex nut combination to hold the entire assembly.

Feedthrough capacitors

Several different types of connector are available for bringing RF into or out of the shielded enclosure. Low frequency and DC lines can also use certain types of connector. Indeed, I've used RCA phono jacks for both signal and DC lines (although *not* on the same project!). I've also used DIN audio connectors, XLR/XLS audio connectors and Amphenol 126-x connectors for DC and low frequency signals. However, there are times when you want to pass a DC/LF line through a chassis or shielded box in such a manner that prevents RF from getting into or out of the protected space on the wire. This is where you need a feedthrough capacitor (called "EMI filters" in some catalogs).

Fig. 3 shows two types of feedthrough capacitor. One form is mounted with a hex nut, while the other form is the soldered type. In both forms values of 500 pF, 1,000 pF and 2,000 pF are usually available. SESCOM (see below) offers some low-cost feedthrough capacitors.

Metal flange boxes

Aluminum flange boxes (**Fig. 4a**) are a staple of the electronics constructor. Some of these products are quite good, and others are not too useful (some are garbage). Flange boxes have top and bottom half-shells that fit together to make an enclosed box.

There are two things to check for when planning a housing for an RF project. First, it should have an overlapping flange as shown in **Fig. 4a**. If the top and bottom are butt-fitted with no overlap, then shun them. Those boxes have neither strength nor shielding. Second, the box should be made with a precision fit. If the top and bottom half-shells don't fit well together, or if there are gaps in the fit at some points, then the box is not much use for RF construction (or sensitive non-RF projects, for that matter).

If you obtain a good quality box with a flange, then you must decide whether or not the shielding is sufficient. The boxes typically come with four sheet metal screws, two on each side, to hold the half-shells together. For most projects in the lower end of the RF range this arrangement is sufficient. However, at higher frequencies you will want to beef up the RF seal by using additional sheet metal screws as shown in **Fig. 4b**. You will probably have to supply your own screws, as I have not seen any commercial

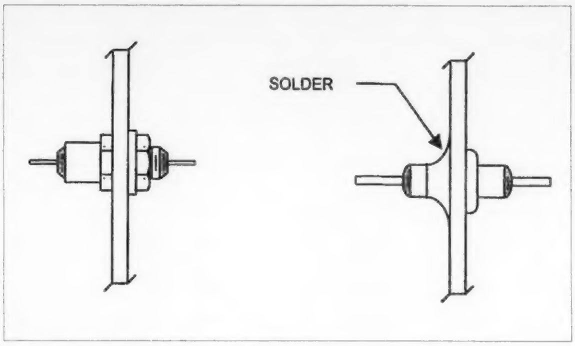

Fig. 3. Mounting feedthrough capacitors.

boxes that come with more than four screws.

If you are either very intrepid, or a bit of a fool like me, then you might want to consider making your own boxes. One of the neat things I learned to do in junior high school metal shop was operate a bench brake. This tool allows you to clamp a piece of sheet metal between two surfaces, and then using a pair of handles, rotate one surface upwards, producing a bend up to 90 degrees in the metal. By properly planning the box "in the flat" and then bending it, you can make your own box of any shape.

Other forms of metal box

A number of times in my building career I've needed specially sized or shaped boxes that were not easily available on the market (although that might change now ... see the SESCOM discussion below). If you go to the type of hobby shops that cater to model builders, you will often find a display of brass sheet metal strips, solid rods and hollow tubing. These can be formed into squares, rectangles or other shapes using ordinary tools. Bending can be done on a bench vise, or using pliers.

If you have access to a jeweler's supply store (or lapidary shop), then you also have access to a number of special tools that are also of use to amateur radio constructors. These tools are used by silversmiths, amateur and professional. A jeweler's saw, for example, is a kind of jig saw that can be used to make very intricate cuts, as well as standard straight-across cuts. If you buy one of these saws, I also recommend you buy a book on making silver jewelry in order to learn how to use the saw.

Jewelry supply stores also have tiny drills that can be used to drill fine holes in printed circuit boards or metal chassis. I've used both the Fordham Flex-Tool™ and the Dremel MotoTool™ for both jewelry and radio constructing. The Dremel (which I actually own) has a large number of accessories that can drill, burnish, grind, cut (you've probably seen the TV ad ... it'll do anything but hammer).

Another little-known but terribly useful tool used by jewelers is the parallel-jaw pliers. These pliers look like ordinary heavy-duty flat-jaw pliers, except that the planes on the inside of the jaws remain parallel as the handle is squeezed. If you try to make a bend in a piece of sheet metal with ordinary pliers, then you will find that it is skewed to one side. The parallel-jaw pliers eliminate this problem.

Plastic boxes

Plastic "utility boxes" have a lot of applications in electronic construction. I've used them for a lot of instrument and power supply projects. However, for most RF projects they are not too useful—they do not have any shielding to offer!

Plastic utility boxes are easy to work, and have some really attractive features (especially where insulation is needed on the outside, or where appearance is an issue). If you absolutely must have both shielding and a plastic box, then there are a couple of alternatives. You could spray paint the inside with conductive copper paint (not all copper-colored paint

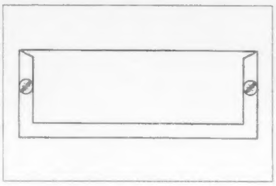

Fig. 4a. Flange box.

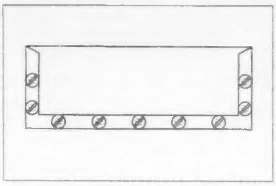

Fig. 4b. Flange box with additional screws.

is conductive!). Second, you can buy thin copper foil and cement it to the inside of the box. Very thin foil can be bought from the type of hobby shops that cater to dollhouse makers. They use the foil to simulate the copper roofs that were once popular on houses. By the way, I've used such copper foil for making shielded small loop antennas.

Passing a wire through a shield

If you make a project that has internal shielded compartments it might be necessary to pass a DC power supply or signal wire from one compartment to another. If the wire carries DC, then a feedthrough capacitor could be used, but for signals a feedthrough capacitor could short the signal to ground. I sometimes use the smallest size grommets to do this job (**Fig. 5**). It works quite nicely. Drill a hole in the partition to accept the grommet's barrel diameter. There are three diameters on a grommet. The outside diameter (o.d.) is the overall diameter of the part, while the inside diameter (i.d.) is the diameter of the hole through the diameter. The barrel diameter (b.d.) is the diameter of the center portion that fits through the hole (**Fig. 6**). One of the mistakes made by some constructors (including me) is to improperly size the hole for the grommet. I match the shank end of a drill bit to the b.d. of the grommet to make the selection.

Some neat boxes from SESCOM

From time to time *73* advertiser SESCOM sends me samples of their small metal boxes for electronics projects. Most of the time, I buy some more for my own because they are so useful. If you've been disappointed with the quality of boxes sold in certain chain outlets, or even from some major mail-order outlets, then you are going to be delightfully surprised at the SESCOM offerings.

First, let me suggest you contact SESCOM for their product brochures: 1) Constructor's Hardware, 2) Audio Construction Made Easy, 3) Audio Solutions, and 4) Lab Box-It™. Let's take a brief look at these products.

For a number of years I've used the SESCOM SB-series RF shielded boxes (see Constructor's Hardware). After SESCOM provided a sample, I ordered more than $100 worth on my own for projects in "Joe's Basement Mental Therapy Laboratory" (where I let the wind out of my head by doing electronics projects!). The SB-series boxes are tin-plated steel with covers that have RF-style "finger flanges." SESCOM also sells low-cost RF feedthrough capacitors to allow DC and low frequency lines to pass in or out of the box without spraying the internal RF all over the place. When you compare the SESCOM price for these capacitors with what you find in the major suppliers' catalogs, you are gonna be impressed!

The latest product samples SESCOM sent are their Lab Box-It™ (LAB-x) and Mini Box-It™ (MPB-x) aluminum boxes. These boxes come in "kit form" and you assemble them yourself. Each kit has two end pieces, top and bottom pieces, two side pieces and four extruded stiffeners for the corners. Tiny sheet metal screws are used to hold the assembly together by fastening the end plates to the

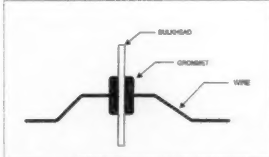

Fig. 5. Using a grommet to pass a wire through a box.

Number 52 on your Feedback card

Above & Beyond

VHF and Above Operation

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QRP transceivers for microwave operation

This month I would like to describe how the San Diego Microwave Group has cranked up the QRP microwave construction mill and produced a variety of low power transceivers. In doing so I want to get into some of the considerations needed to make a transceiver function using low frequency drivers, such as two-meter or similar multimode rigs.

The bands that rigs were constructed for include 1296 through 10 GHz. The equipment was all home-constructed from "found" surplus or some of the excellent surplus electronic materials we obtain from Qualcomm Electronics.

We are fortunate that Qualcomm has allowed our group access to surplus material for amateur radio use only. Our group breaks down the material to prevent the original equipment from being recycled back into commercial use. Parts that are usable to the amateur radio community are made available. The main unit to be briefly discussed here is the synthesizer our group and many others have used as the basis for a transceiver converter for many of the microwave bands.

The easiest rig or microwave transceiver that can be constructed using these parts is a QRP rig for 2304 MHz. While we are able to obtain materials from Qualcomm to assist us in this construction project, other sources must also be used. The main ingredient obtained from Qualcomm is the synthesizer/local oscillator. The basic synthesizer operates at 2620 MHz and is converted to 2160 MHz for mixing with a high-frequency IF radio. A two-meter radio (IF) was selected, as this gives the filters a chance to remove the lower mix product 2016 MHz (2160 -144 MHz).

Many parts need to be assembled to construct a complete converter. The basic components are the same for every one. They include an RF preamplifier, transmitting amplifier, mixer, filter, and RF/IF switching. The converters I will describe will be constructed to operate from 12 volts DC and be driven with a two-meter low-power HT or similar transceiver. Because the transverter is linear in operation, it can be used on any mode of transmission but is especially suited for narrowband FM, SSB, and CW. All modes of transmission are supported in an identical fashion, as you only have to change the mode on the driving HT or rig to change modes. No circuitry changes in the transceiver are required for this operation.

Normally SSB is the preferred mode of transmission for most operations. FM is reserved for stronger signal paths or those such as mobile operators who often have very distorted SSB speech because of Doppler paths arriving at varying times. In this case, narrowband FM can cut through the clutter of the Doppler and make communications readable—providing signal strength is strong.

This type of transverter is normally driven by a multimode two-meter source. The only requirement is that the driving source be of low power on transmit to prevent burnout of the transverter's mixer. If the two-meter rig can output high power levels to the mixer, a piece of "unobtainium" could be destroyed. To prevent this, my two-meter rig, an old-style two-meter transverter, was modified by removing the power output stage to prevent any possibility of high power feeding the mixer.

This is a drastic step and those with expensive, newer two-meter radios might not want to take it. The alternative is to place an attenuator in the coax to reduce the power to acceptable levels for injection to the mixer. Normally, a power level 50 mW or so, near the +10 to +15 dBm level, is perfect. It is low enough that it will not cause mixer burnout and yet still high enough to provide proper injection to the mixer. You can push this drive level with higher level mixers to something near +17 dBm as a maximum drive level.

In receive, you will have to switch out the attenuator to have maximum sensitivity on receive. If you were to leave in a 20 dB attenuator that would be required for use on a 10-watt rig, it would attenuate the receive signal by 20 dB as well. By switching out the attenuator on receive, you allow the receive section to operate with maximum sensitivity. This switching circuit can be either an automatic relay selection circuit or a simple toggle switch affair.

If you choose to use a toggle switch, be sure to throw it to transmit prior to actually transmitting, as the 20 dB protection attenuator is not in the transmit path unless the toggle switch is operated first. In manual operation with a several-watt rig for the two-meter transceiver, it can be an easy slip of the hand to get out of switching sequence and destroy the mixer with high power. It is indeed an expensive price to pay for not using mixer switching protection, since mixers for the microwave bands are not inexpensive.

The best remedy to avoid this problem is to incorporate some switching protection for the mixer. Several variations of this scheme can be used to great success. The circuit that can be used for protection from a 10-watt

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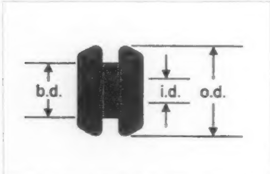

***Fig. 6.** Standard grommet.*

extruded stiffeners. A standard #1 miniature Phillips™ screw driver will do the trick. The side and top/bottom panels are held in the stiffeners by sliding them into the slots on the stiffeners.

There is a wide variety of sizes of both forms of box, so most constructors should be able to find what they need. As an experiment, however, I decided to make a custom size box from one of the LAB-x boxes. I used a jeweler's saw to cut the extruded stiffeners to a custom length. It was a bit tricky to ensure that all four cut stiffeners were the same length, but a little work with a fine Swiss file did the trick (recommendation: cut them a millimeter or so over length and then file them down). The sides, top and bottom panels are made of aluminum, so they cut nicely with a pair of straight sheet metal shears (don't use the curved-style sheet metal shears).

One of the really neat things about the LAB-x series of SESCOM boxes is the variety of end plates that are available. The boxes come with blank end plates, so you can drill your own holes. But a number of different pre-cut end plates are also available. Included in the list of "specials" are:

A) 0.25-inch for RCA phone jacks.

B) 3/8-inch for quarter-inch phone jacks and standard bushing rotary switches and potentiometers.

C) Two 3/8-inch (see "B" above).

D) Two 5/16-inch banana jack holes.

E) SO-239 chassis mount "UHF" coaxial connector.

F) 3/8-inch "D" shaped for BNC connectors.

G) 1/2-inch "D" for isolated BNC connectors.

H) DB-9 and DB-25 computer connectors (ever tried to cut one of those with a Swiss file?).

I) Special holes for male and female XLR audio connectors.

Not all styles of special end plate are available on all boxes, but the assortment is broad enough to allow most builders to save a lot of time.

Connections

I can be reached at the address listed at the top of the column.

SESCOM: 2100 Ward Drive, Henderson NV 89015-4249; 1-800-551-2749 (orders), or (702) 565-4828.

transceiver (two-meter) can be constructed from a few extra parts. These parts are added to the mixer port to prevent direct contact between the transmitter and mixer port.

What the circuit consists of is a basic MMIC op amp driving a fixed resistive attenuator. The type of MMIC is not critical, as the frequency of operation is quite low—in the 145 MHz range. The gain of the op amp is determined by the value of the attenuator required to limit transmitter power to the required drive level. For instance, my Yaesu FT-480 two-meter multimode rig puts out 10 watts of power. Inserting a 20 dB attenuator reduces the 10 watts to 100 milliwatts (10 watts = +40 dBm, 1 watt = +30 dBm, and 100 mW = +20 dBm).

In the transmitter path, a fixed 20 dB attenuator would be switched into the transmitter path towards the mixer when transmitting. The op amp and another 20 dB attenuator are connected in the normal receive path. This combination has zero gain, so on receive its action is transparent. Should the switching fail, transmitter power will be attenuated by the receive 20 dB pad and feed the op-amp output backwards. Feeding the op amp backwards is additional protection against power getting to the mixer.

This receive attenuator can be made from two-watt carbon resistors. The transmitter's 20 dB attenuator should be capable of handling the full 10 watts. In this scenario, there is no damage to either the mixer, op amp, or attenuator.

This changeover can be automatic, derived from an RF-detect circuit on the IF coax path, or it could be nothing more that a simple manual toggle switch. In either case, with this power protection circuit the transverter's mixer is protected from certain switching errors preventing high power to the mixer, *and* replacement costs for a new mixer.

There have been many different switching circuits labeled fail-safe that would switch attenuators in the transmit path prior to power output from the IF driving transceiver. Our Microwave Group has found several two-meter rigs that even when in the low power mode will output high power for a small fraction of a second. This short burst of power is too quick to be observed on a normal metered power meter. So it's better to assume that all rigs can present a danger to a costly mixer. Protect it!

If you are a dedicated microwaver and have the microwave frequencies in your blood, you will probably do as I have and remove the high power capability of your driving IF radio. No one likes to cut into the circuitry of any new radio to modify it, especially since the cost of a multimode radio today is quite high. However, if a used multimode were to be modified, there are several approaches that can be taken to minimize the permanent modification to the radio. These are alternatives to the RF switching protection circuit.

Most of these radios have a low-power switch which will limit power to less that two watts or so. Don't depend on this switch, since being a switch it can be depressed—and you're in trouble with too much power to your transverter. The solution I took to this problem is to open up the radio and determine from the schematic or measurements what function the switch is performing. Then duplicate it in hard wiring, making the switch function permanent. Now if you accidentally operate the low-power switch, you're still permanently switched to low power and can't go to high.

The beauty of this simple modification is that with minimum effort you can return your radio to normal function in a matter of minutes by clipping out the switch wire strap.

Another possible modification is to remove DC power to the final RF stage. This trick was discovered when low power was reported as trouble on a friend's radio. In this case, the actual trouble was that the final transistor was blown open possibly through poor SWR or whatever took the device out (if the transistor has failed in the shorted mode, this trick won't work).

In retrospect, the driver was putting out less than a watt with the final transistor in this "blown" state. Another creative way to reduce maximum power output is to do what Kerry N6IZW did to a old ICOM IC-245 rig. He modified a pre-driver RF amplifier stage that was emitter-biased with a 10 ohm resistor to ground. Changing this resistor to one of about 1 kΩ permanently powered down the amplifier strip to about 100 mW.

This pre-driver stage was now just tickling the driver with minimal RF to barely turn on the driver and final with insufficient drive for full power output. This was just what the doctor ordered: a permanent condition forcing the transmitter on low power of 100 mW output all the time with minimal modification. To restore this conversion to normal, just short the 1 k resistor in the emitter circuit with a 10 Ω resistor and the transmitter is back normal. What could be better than limiting drive to the pre-driver and driver/final amplifier string? Power was adjusted to obtain just under 100 milliwatts of output power, by trimming the 1 k resistor to the proper value for the power output required.

In this manner, the modification took a few parts and some surgery but still allowed the radio to be retained in nearly intact condition. I plan to modify my IC-245 in the same manner. I also want to incorporate a power switching circuit to switch between transceiver driver circuits and normal 10-watt operation. I will investigate just what kind of switching method can be used to allow bulletproof, fail-safe switching between power levels.

I know what I said about the dangers of unreliable power switching (toggle or slide switch), but I'd like to see if something can be done reliably—possibly the addition of a plug connector or a key-actuated toggle switch on the radio. When the plug is removed or the key is inserted and turned in the switch lock, the radio is in permanently-low, 100 mW power output. Inserting the plug or turning the new switch off switches the bias circuit back to the 10 watt position. At least that or something similar to that position is what I am pondering and will tinker with.

A last word about two-meter multimode radios. I am not too hot about one feature of the ICOM IC-245 radio for portable work. The problem lies in the red LEDs in the frequency display. When used in portable operation (out in direct sunlight), the display is quite hard to read. Even in most outdoor conditions, you have to shade the display and squint to see a faint display. It's not the radio's fault but instead just the design of the frequency display and the use of the red LEDs.

This problem is quite prevalent in early two-meter multimode radios of this period. The exception to this rule is the ICOM IC-202, which has a velvety smooth VCXO-controlled dial with operation limited to (LSB) SSB only. Another possible radio is the Yaesu FT-480 multimode rig, which uses a green fluorescent display and is quite bright in direct sunlight. It's another example of older multimode radios that can be made quite valuable as drivers for microwave converters.

New radios are available, with the most inexpensive multimode model being by Yaesu, the FT-290R. This radio is still being offered by Yaesu for under $600 brand new. Ham Radio Outlet™ and other retailers have it, I am sure. The rig sports full multimode operation and an LCD display that can be observed in direct sunlight. It will output 10 watts from 12-volt installations but with the optional battery pack will put out two watts for portable stations. Sounds just like the thing to think about if you want to start with a new multimode radio. It's not overly pricey, has multimode capabilities, and has a display that can be used in daylight or direct sunlight.

Well, that's it for this month and some of the approaches we have put to use in converting our low-power two-meter radios. High power is not always the answer. Indeed, it's very interesting how low-power applications can be quite satisfying. With power levels under a couple of watts on most converters, very interesting propagation and just good old fun are always available with QRP operation.

73 for now, Chuck WB6IGP. 73

QRP

Low Power Operation

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Have you ever had one of those days when everything you touched fell apart? Well, *I* sure have. In fact, the last several weeks have been filled with days just like that. Seemed everything I looked at, touched, or read about fell apart or just plain broke on me. After unloading box after box of radio equipment from storage, I decided to check each and every piece of gear out before placing it once again in service. Hindsight always being 20/20, I should have left everything in the boxes.

Out from the stack of junk came my banged and beaten Century 21. If you recall, we repaired this thing some time back. It seems the hand of death has closed upon the ol' Century 21 once more.

A brief look at the Century 21

Just in case you missed it, the Century 21 is a multiband transceiver. The Century 21 covers 80, 40, 20, 15 and 10 meters. You can install an optional crystal for more segments of the 10-meter band if you wish. Oh, yes, lest I forget, the Century 21 is CW only—there's no SSB on this guy!

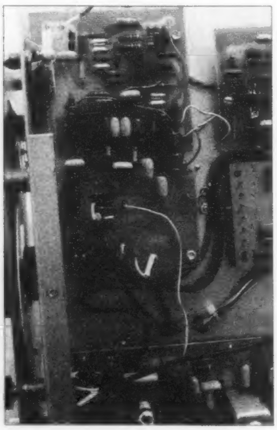

Photo A. The audio mixer and preamplifier board inside the Century 21. This board is located on the bottom of the chassis.

The Century 21 has a direct conversion receiver. It has neither IF amplifier nor IF mixers. RF signals are directly mixed with the VFO to produce audio. There's more than enough audio to drive the internal speaker to glass-breaking volume. An internal power supply runs the entire rig, which is something most direct conversion rigs can only dream of.

RF flow in the Century 21

Perhaps we should look at the RF signal flow from the antenna to the audio stages.

Signals from the antenna are first routed to the RF front end, circuit board 80359. Here, signals from the crystal oscillator are mixed RF from the antenna. The resultant signal is now routed to the audio preamp board, 80356. On this board, the direct conversion of RF signal to audio happens.

And the magic that makes this happen is called the receiver product detector. In the Century 21, the product detector is composed of four matched diodes. This arrangement is called a passive detector.

In direct conversion receivers like the Century 21, the resultant audio is amplified, filtered, and then amplified once more. All of these bring us to the problem at hand: distorted audio.

The problem in detail

After I had the rig up and running, I let it cook on 40 meters. After a half hour or so, the audio from the speaker began to sound distorted and finally it failed. By poking inside the rig, I could make the audio pop up, but it was seriously distorted. It sounded like the speaker was shorted internally.

So, a quick test or two was in order. First, the shorted speaker was quickly ruled out by using a spare speaker. The classic fingertip on the volume control seemed to produce a nice large buzz from the speaker.

Keying the rig showed 35 watts RF output on the correct frequency. However, there was no sidetone being generated. To top things off, the audio filter seemed to be inoperative as well.

All the voltages into and out of the modules were within specifications. No, the trouble had to be in either the preamplifier or the filter. No sidetone, no filters, the problem just had to be on the 80356 audio preamp board.

Getting to the board

Naturally, the preamplifier board was one that does not plug in. It's hard-wired to the rest of the Century 21's plug-in boards.

To remove the preamp board, you need to first remove all the knobs and control hardware. Then you can remove the front panel. I found an easier way.

There are several sheet metal screws holding the preamplifier board down. Also, there is one solder joint to ground that must be undone to allow the board to be lifted up. Remove these screws and the solder joint. This solder joint is located near the center of the board at the inside edge.

First, remove the knob from the selectivity control, then the knob from the volume control. Set these aside for now. There's a metal bushing on the volume control shaft. This bushing gives the panel strength and allows the panel mounted nut something to tighten down on.

To get this bushing off, remove the panel nut first. Next remove the panel nut from the selectivity control. Now, with a thin open-end wrench loosen the chassis nut. As you loosen this nut, push the already free PC board back. Keep turning the nut and pushing the board back toward the center of the rig. You'll be able to push the board back enough so the bushing falls out. Remove the board, but don't pull any of the interconnecting wires out of their sockets.

The Century 21 is no spring chicken! The circuit boards are now showing their age. To make matters worse, when the boards were stuffed, all the pins on the ICs were bent over. This makes removing a chip a big problem. Normal desoldering techniques no longer apply. What I had to do was heat up the joint and with a sharp knife point, gently pry up the IC pins one at a time. Of course, no matter how careful I was, I managed to lift up a trace or two from the PC board.

I removed both ICs on the printed circuit board. I was so sure they had to be the problem that I didn't even take voltage measurements on the IC pins—that was a big mistake!

After a few dozen Hail Marys, it was back inside the rig once more. This time, I took my VOM with me.

All the voltages at the ICs were exactly where they were supposed to be. It was clear the problem was not located on the audio preamplifier board. As Mr. Sherlock Ohms was heard to say, "After you remove the impossible, whatever is left, however improbable, must be the truth."

What was left after removing the impossible was the audio power amplifier itself. This time, voltage checks were taken and they revealed several major problems. The audio power amplifier is based on a LM380 audio amplifier, located on the audio power amplifier board 80357. All indications pointed to a bad LM380. A new part was installed and guess what? The problem remained—as well as the weird voltage readings on the IC itself.

A closer look at the audio power amplifier showed the IC had pins 3, 4, 5, 6, 7, 10, 11, and 12 all at ground. Voltage readings showed several of these pins were, in fact, riding above ground!

The problem was finally found when a second LM380 was installed. And the problem turned out to be the heat sink holding the LM380. It appeared the heat sink was riveted to the printed circuit board. The rivets did double duty—they held the heat sink to the printed circuit board and they supplied the required ground. You see there are three ground pins on the LM380 on each side of the chip. These six leads are soldered to the heat sink. With no ground to the metal heat sink, the six

Number 55 on your Feedback card

The Digital Port

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Worldwide contacts

I've used a lot of space recently dragging you through the software hassles of packet, but ignoring some of the real fun you can have with this mode once you get everything in place. This month I will concentrate more on the fun side.

When you choose ham radio as a hobby, you expect to make contact with other people using radios. Hams have been doing just that since the early part of the century. There was, of course, a time before voice modulation when Morse code was the mainstay and was done without the aid of vacuum tubes. Imagine being the envy of the neighborhood with your home-brew spark gap, and living in such a grand era with *no possibility of TVI*.

Hams are always on the cutting edge

The fascination with ethereal communications has attracted the serious, inventive adventurer to the ham bands for decades and digital modes now add new dimensions. Just the other day, I received a message via the regular packet network from a ham in Austria, Walter OE4TEA. He has a nice little file he inserts in his messages that gives his addresses for packet, the Internet and amateur packet via satellite.

And that is just a sampling of the many methods of ham communication we have available. Most of us focus on one or two modes and miss out on a lot of action such as amateur TV, fax, satellites, EME, and propagation phenomena such as meteor scatter or aurora. Plus, most of us ignore the extreme short wavelength bands available to us.

There is another modern day development that many hams take advantage of. We were just visited by some friends from the neighboring state of Idaho. It is only about 500 miles to his ham antenna from here but we seldom make contact on 80 or 40 meters because of the high noise level at his end.

Communication is about to be revived. While he was visiting, Graydon WB7PWS asked if I had an Internet address. Since he does not have a packet station, we will soon exchange regular E-mail via the landline—one more modern development that keeps us in touch.

I get E-mail

Since I have my Internet address listed in this column, I receive a considerable number of requests for information that I don't thoroughly cover in the printed copy. I like it when I know someone is reading. Not too long ago, I got an E-mail request from a student in Italy inquiring about budget packet projects.

It is not unusual to receive requests for Internet addresses related to ham software, when I neglect to include the address on an intriguing item I have found and described. Sometimes it doesn't occur to me how valuable that information is to a reader. With the easy availability of the Internet those problems are easily solved—at affordable rates.

Occasionally I receive helpful guidance when I let it be known that something in my trusty computer is not functioning the way it should and I am at a loss for a reason. I appreciate those messages, believe me. I am not an engineer, and even if I were, the explosion of technology in this field would be beyond the grasp of the best to keep on top of everything.

What I am saying is not meant to belittle my abilities, but to reinforce the premise that ham radio is a group of ordinary people like you and me who reach out to help one another. I learn continuously as I write this column. My primary purpose is to put ideas out to you that encourage and help you solve your problems.

Encouragement is one of the keys to successful ham radio

If some helpful Elmer hadn't reached out, most of us would never have persisted to get our first ham ticket. So, in a way, this column is a project in creating enthusiasm so you will keep after this digital adventure until you whip it. If it tells anything about me, my dog is named Elmer.

An informative, well-formatted packet message came from Geoff VK5MG relating his experiences with packet radio from Down Under. He told how he managed to get his BayCom™ modem working with Winpack™. I sent him a reply and explained my dilemma with getting a Windows™ program to talk to my BayPac™ and he sent me info on what he had specifically used for the project.

Coincidentally, I had been working with the same software and it looked like I was heading in the correct direction. For the rest of those curious about this software, I will give you a rundown on how you can get the programs and, most importantly, the instruction sheet.

The concept is based on utilizing the popular BPQ node software authored by Roger G8BPQ. With this in place you can address your internal node easily with any terminal software including your favorite Windows-based program. The secret is to use a program, NODE2BAY, to interface the node to the BayCom modem. Actually there are two programs required to accomplish this. The other is a driver, BAYDRV.VXD.

These files are available on the Internet and I have not noticed them elsewhere. Winpack has become popular and can be found on many on-line services as well as the Internet. I downloaded my copy of Winpack from the TAPR Web site [www.tapr.org].

The programs BPQ, NODE2BAY and BAYDRV that I referred to above are available from [http://www.peaksys.demon.co.uk] and they are well identified. On the same site, Paul GW7LHI has an excellent set of instructions for setting all this up. Paul's paper is about eleven pages but is in a very clear, can't-miss (nearly), step-by-step format.

I only say nearly because I found an error in reference to a batch file you must write to get this going. Actually it is merely a reference in the autoexec.bat line that you must enter that refers to the address for the batch file. So if you do this, pay attention and point the line in the autoexec.bat toward the correct subdirectory where you place the batch file that puts the show on the road during the boot process.

This foray into the world of tiny software-controlled modems has been a real eye-opener for me. The work on this area of packet radio is being primarily conducted in Europe and it is possible to build your own interface, either from a kit or piece by piece from your own parts supply. Instructions are available from some of the software publishers. My copy of

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leads were, in fact, just sitting there floating. How the amplifier made any noise is beyond me.

The fix was simple. The rivets were removed and short pieces of hookup wire were soldered in place. At power-up, signals came pounding through the speaker—the Century 21 lives once more!

All told, the repair on the Century 21 took over a week of my time. Had I looked first and not jumped into the project without thinking, perhaps the down time would have been different.

QRP station goodies

Did you find yourself calling and calling CQ FD over and over again? That's a pooper in anyone's book. Most of us don't own a memory keyer, but the people at Jackson Harbor Press may change all of that. You see, they have a slick memory keyer that works with the keyer you may already have. It's called the Island Memory. For more information, see the review in *73* (May 1997), or send them an E-mail at [jacksonharbor @worldnet.att .net]. 73

PROGRAMS FOR THE BAYPAC AND BAYCOM MODEMS				
Program	**Success**	**Difficulties**	**Support**	**Available At**
BayCom 1.4	Excellent – works every time	DOS only – Windows must be shut down	Freeware – support possible from newsgroups	www.tigertronics.com or comes with modem
Wintnc	Very good – runs/Win95	Some nodes do not read requests	Shareware – author may not respond	www.tigertronics.com
Winpack w/BPQ NODE2BAY & BAYDRV	Good if using right setup (see text)	Complex setup did not perform with my laptop	Shareware All pgms –check at dl area at right	[all] www.peaksys.demon.co.uk [Winpack] most ham boards
HamComm 3	Good	Software works but my laptop gave problem	Try newsgroups	www.tigertronics.com
AgwBay AgwTerminal	Not tried	N/A	Freeware – contact dl site	www.forthnet.gr/sv2agv

Table 1. *These are just a few of the available programs for the BayPac BP-2M and BayCom modems. The only definitive commercial package is the BayCom 1.6. Haven't tried it. The authors of most of the programs have only run them on a few computers. Sometimes they work for one person and not another. Everything is written by hams who have real jobs to keep the wolf away—so you work with what you find that works for you.*

the documentation for the HamComm shareware program gives a schematic and parts list.

The challenge comes in writing the software to do the job. There is a great effort being expended in Europe to write such software—and it seems to be equal to the work on this side of the waters that goes into the design and refining of multimode hardware and sophisticated software for all the other digital modes.

Some of the problems I have encountered are related to my own hardware and my local packet BBS. I have not found explanations for some of the problems, but there are some combinations that work. I have been focusing on a portable digital station based on my IBM laptop. Some of the bells and whistles of Windows 95™ tend to stifle progress.

I'm using the newer laptop because I have other uses that require Windows-based programs. However, I have come across warnings that some of the earlier DOS-based laptops also offer resistance to packet operation. This means to me that we still have an experimental hobby situation.

Some *new* news

Just as I was wrapping up the thoughts for the month, I took a look at my E-mail and found a posting from George SV2AGW on one of the TAPR newsgroups. He claims to have developed a driver for the BayCom that allows any Windows 95 terminal software to function just as if using a regular TNC.

George conveniently left a clickable [http://www.forthnet.gr/sv2agv] embedded in the message. I couldn't resist taking a look and found some good information along with several programs. I downloaded the driver and his terminal program. There won't be time to install and test it before I send this off, but I will take it with me when I go out of town next week. In a true gesture of ham goodwill, George is offering his programs as freeware! Now, *that* is an incentive.

I mentioned so many programs this month and earlier for the BayPac BP-2M that I put them in chart form (**Table 1**) so you can have ready reference. There are more out there. Just check the TigerTronics™ Web page. I just listed the ones I have tried or intend to try.

If I can put this month's column into proper perspective, that's what I like about ham radio. You get to work on it until it works—then, when it does and you know you did it yourself, you get your well-deserved thrills. A digital connection to a station on another continent or a node across town always brings that little tingle about sophisticated equipment that works because you made it do it.

Speaking of thrills, I now have a laptop that, with a few keyboard calisthenics, I can use to make a packet connection wherever I travel. For me, that provides a little excitement every time I see it work. Not world-shaking by today's standards, but something I didn't have a year ago. I still haven't mastered all the bells and whistles available from my BayPac BP-2M, but that gives me something more to look forward to.

Ham radio, by its very nature, gives each of us something to look forward to, that we can accomplish on our own—or if not, with the help of a ham friend. That's what it's all about.

If you have questions or comments about this column, E-mail me at the address in the column heading and/or CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line [KB7NO @ N7NPB.#NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO.

Number 57 on your Feedback card

Ham to ham

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
[dmiller14@juno.com]

A bright spot in your day

Here's another workbench pin-up that you might want to keep somewhere handy, a simple LED limiting resistor chart. **Table 1** shows the chart, which probably needs little further explanation. Most light-emitting diodes (LEDs) require a properly chosen current-limiting resistor to keep them from self-destructing, which can occur almost immediately if the resistor is inadvertently omitted. The values in **Table 1**, however, can act as a quick reference to the proper size of resistor for supply voltages from three volts to 12 volts, using standard-resistance values and keeping the LED forward current at about 10 to 12 milliamperes (which is safe in the majority of devices). Some LEDs can handle more forward current (20 to 25 mA), in which case the value shown can be cut in half. Others may perform better with less continuous current (5 or 6 mA), in which case the resistor value shown can be doubled. On average, however, most currently made LEDs seem to work nicely with the exact values depicted in the chart at the various supply voltage levels shown.

Table 2 shows the results of a spot check of several LEDs from my own collection, with exactly 12 VDC applied across the 1 k resistor/LED combination. From my brief experiments, the red LEDs seem to have the greatest variation in forward current through, and voltage drop across, the device from one to another, in a random pick ... just an observation. *—de NZ9E.*

12 volts	1 kΩ
9 volts	600 Ω
8 volts	470 Ω
6 volts	330 Ω
5 volts	220 Ω
3 volts	68 Ω

***Table 1.** Approximate LED limiting resistor values for 10 to 12 mA forward current.*

Joys of the J-pole

From Marcel Chapleau VE2GMZ: "A few months ago, I decided to build my own J-pole antenna for two meters and 70 cm, instead of buying a considerably more costly factory-made unit. In going through my old ham files, I ran across a design that looked about right for my needs. The original was written up by John Post KE7AX and I copied his design for my first attempt.

"The antenna described by KE7AX worked out well, but I did notice two things that I felt could be improved upon. On a J-pole antenna, the coax cable is attached to the lower portion of each element (about two and one-quarter inches up from the horizontal connecting piece) while watching the SWR presented to the transmission line. At best, I could only achieve about 1.3:1 on two meters and 1.6:1 on 70 cm. Not bad, but there was room for improvement.

"Squeezing the 19-inch vertical radiating element closer to the 60-3/4 inch element (at the top of the 19-inch pipe) showed a drop in SWR to very close to unity. Based on this finding, I made up an 'L'-shaped angle bracket two inches long by one inch wide and with a one-inch drop-leg, and configured a one-and-one-half-inch slot across the top two-inch length. This allowed me to attach the 'L' section to the flat top of the 19-inch radiator's cap-piece with a single machine screw, and provided me with a 'Fine SWR Adjustment.' Now I can simply slide the 'L' piece back and forth on the 19-inch element until the SWR is as close to 1:1 as possible.

LED Color	Forward Current	Voltage Drop Across LED
Yellow	9.7 mA	1.98 volts
Green	9.57 mA	2.09 volts
Red	9.30 mA	2.36 volts
Amber	9.72 mA	1.93 volts
Blue	8.77 mA	2.91 volts

***Table 2.** Results of spot check of several LEDs, with exactly 12 volts DC applied across the 1 k resistor/LED combination. The limiting resistor was kept constant at 1 k ohms.*

"With just that addition, I installed the dual-band J-pole at my home QTH and used it quite often for several months. I was able to reliably access a repeater 50 miles away, as well as the Russian *Mir* space station on a number of occasions. I felt, however, that the angle of radiation might be too high for good space communications (*Mir* was mainly only usable between 20 degrees to 65 degrees), so I decided to try something else. I constructed two sets of four-spoked radials, one for two meters, and one for 70 cm. The 70 cm radials (each six and one-half inches long) were then positioned six and one-half inches down from the bottom of the 'J' crossover piece, and the two-meter radials (each 20 inches long), another 13-1/2 inches farther down (a total of 20 inches from the 'J' crossover). The details of the entire antenna are shown in **Fig. 1**. My reliable repeater 'reach' now increased to 95 miles

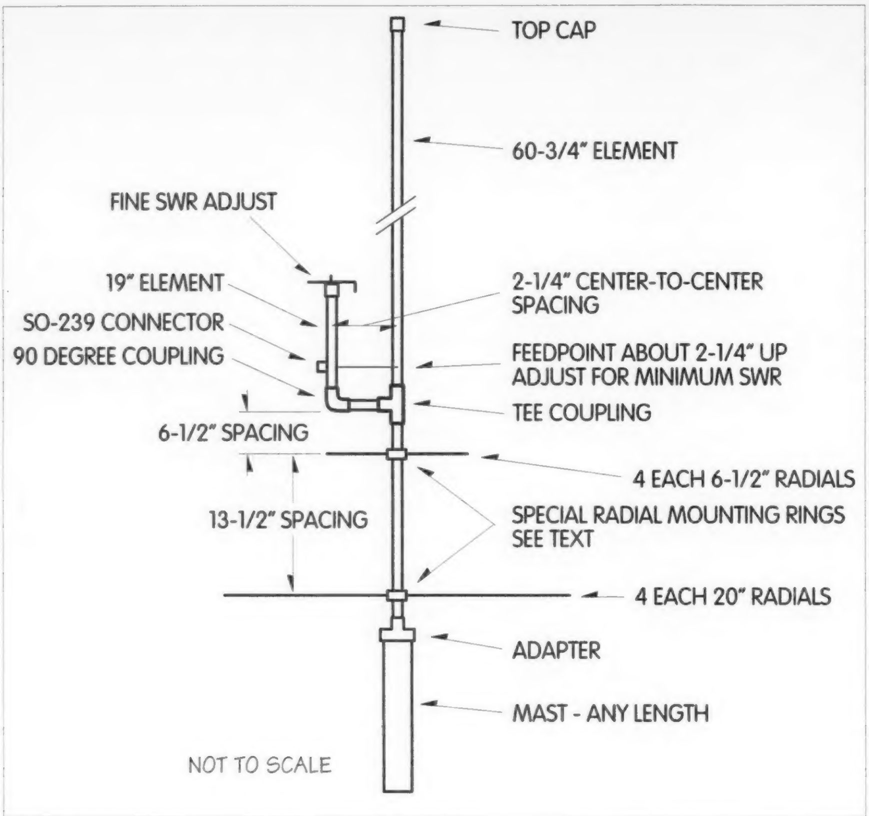

Fig. 1. *VE2GMZ's "dual-band" J-pole antenna for two meters and 70 cm.*

away, and I'm able to talk with a friend 45 miles down-range on simplex, just using the J-pole with its added radial 'skirts.' Communications with *Mir* were not as gratifying, however, and I suspect that perhaps the angle of radiation may now be too low.

"Needless to say, for terrestrial coverage, I've been very pleased with the results for my meager investment, and I thought my experiences may have appeal to others in the ham community."

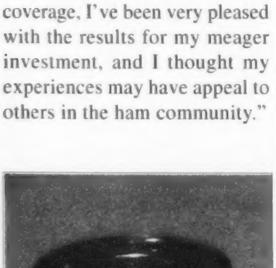

Photo A. *VE2GMZ's radial mounting ring.*

Moderator's note: Marcel's dual-band J-pole dimensions are shown in ***Fig. 1****, and the radial mounting ring that he made up is pictured in* ***Photo A****. Normally, a J-pole doesn't need a ground plane or radials to perform correctly. I suspect that Marcel's added radial system (for both two meters and 70 cm) tends to "decouple" the coaxial transmission line from the antenna, so that any common-mode currents that might exist on the transmission line are suppressed, and the shield of the transmission line is no longer a part of the active "radiating" portion of the antenna. This isn't uncommon at VHF and UHF frequencies, proving that "apparent" theory and "real-life" practice are often somewhat at odds. Never argue with success!*

Marcel has kindly offered to make up copies of the special radial mounting ring that he devised for his antenna for "Ham To Ham" readers. The sample radial mounting ring that he sent me is nicely machined from 3/4-inch aluminum stock and has four holes around its perimeter to accept copper welding rod "radials." The radials are then locked into place with Allen-head setscrews at all four points. A half-inch hole passes through the center of the ring for fitting onto the half-inch (o.d.) copper pipe used in constructing the antenna, and it too is locked into place with an Allen-head setscrew. Marcel is offering a retrofit radial kit consisting of two mounting rings and two sets of radial wires, for those who might not be able to do the machining themselves, for $20 (US funds) including shipping. Write to VE2GMZ at the address at the end of the column for further information or to order the kit just described.

A switch for a switch

From Craig Stimson VA3DCS: A suggestion for an easy way to build a packet/voice TNC/mike switch: "Do you have a 25-pin computer A-B data transfer switch just gathering dust on the shelf? Looking for an inexpensive way to switch between my packet TNC and my microphone, I decided to give the spare data switch that I had a new purpose in life! Something of a role-switch for a switch! I fabricated three special cables: one DB-25 to an eight-pin mike connector that would plug into my transceiver's mike input jack; one DB-25 to the audio connector used on my TNC; and one DB-25 to the correct-gender eight-pin connector into which my transceiver's microphone would mate. Connecting everything together as shown in **Fig. 2** gave me the mike-to-TNC A-B switch that I needed, for just a fraction of the cost of a commercially-made unit. Just be sure to be consistent in your wiring so that all pin-to-pin interconnections are correct for your particular setup, and that shielded pre-made 'DB' connector cables are used for the external adapters."

Moderator's note: That's a clever "alternate" use for an A-B data switch, Craig. Even if you don't happen to have one on the shelf, they can be found quite reasonably at every ham and computer fest. Also, check out the catalogs of some of 73's advertisers; you can sometimes find the DB-25 A-B switches for about $5 and pre-made dual-ended DB-25 cables for $2 or $3. In addition to using only shielded interconnecting cables, it's also a good idea to ground all unused conductors at both ends; this will help in fending off RFI induction into the low-level microphone circuit.

Battery BASICs

From Joseph Gabus AB5RE: Here's a handy BASIC program for readers. "Back in the February 1997 issue of *73 Amateur Radio Today*, J. Frank Brumbaugh W4LJD wrote a nice article titled 'The Gel Cell Storage Battery—A great little power supply,' in which he makes the case for why it may make better sense at times to use lead-acid-based gel cells to power portable amateur gear than other competing battery technologies. To most effectively use the information in Frank's article, however, it's necessary to compute the expected operating time based

upon the expected average transmit/receive duty cycle vs. the battery's ampere-hour capacity for each different battery type (i.e., amp-hour capacity) under consideration. To make the job easier and less prone to computational error, I've come up with a simple BASIC program that can be used to complete the task. Since it's written in BASIC, it's easy to modify for those familiar with that programming language, and it will run under on any computer that can utilize a BASIC interpreter; if you're using a modern Windows™ computer, you can use the QBASIC program in DOS. (See Sidebar.)

"I've called the program GELCELL.BAS. After inputting the data and calculating the results, the program gives you the opportunity to print a hard copy of the results as well as to compute another set of variables for a different battery—simply answer 'y' or 'n' to these questions. There is also a reminder printout at the top of the screen showing the results for the last computation. Line 115 gives the user the option of adding any other constant-current accessories into the calculations. It can be removed if none are ever used, or simply push <ENTER> to default to zero.

"By using GELCELL.BAS, I found that my MFJ-40 CW transceiver (which draws 1 A during transmit and .05 A during receive) could potentially operate for 80 hours, before recharging of the battery would be needed during an emergency, using just a 10-ampere-hour gel cell battery. Adding the constant current of a Radio Shack™ DSP-40 signal processor, however, raised the current demand enough to require approximately a 90-ampere-hour battery for roughly the same operating time. In that case, better bring along a husky assistant to help carry the battery!"

Moderator's notes: I asked ***Frank Brumbaugh W4LJD*** *to comment on Joe's implementation of the information outlined contained in his article. Frank wrote back:*

"When calculating transmitter current drain, the duty cycle (the amount of time that the transmitter is actually drawing full current during the transmit mode) must also be taken into account, as well as the ratio of receive (or tuning around time) vs. actual on-air QSO time. A 50% duty cycle is generally assumed for both CW and SSB to be on the safe side. Other modes, such as RTTY, FM, or AM, must be figured as 100% duty cycle while transmitting. Let's further assume that a normal routine might be tuning or listening for 50 minutes (5/6) out of an hour's time, while transmitting may only occupy 10 minutes (1/6) of that same hour. With the 50% duty cycle of CW or SSB, the following formula can be applied:

Current during receive = .050 A (50 mA)

Current during transmit = 1.0 A (1,000 mA)

Battery's rated capacity = 10 Ah (Ampere hours)

(5/6) of .050 + (1/6)/2 = Amperes for one hour

.042 + .083 = .1253 Amperes (125.3 milliamperes) for one hour

Battery Ah divided by Amperes-per-hour = maximum operating time

10 over .1253 = 79.8 maximum estimated hours of operating time

"The above assumes that the qualifications mentioned previously are completely accurate, of course. Any estimate of actual duty cycle is simply that ... an estimate. Additionally, you would not want to run your battery right down to fully discharged, at least not intentionally.

"Lacking a computer, you can use a hand-held calculator and get the same results by using the formula shown above.

"By the way, anyone who might be interested in pursuing the question of the care and feeding of gel cells more thoroughly can contact Power-Sonic Corporation at P.O. Box 5242, 3106 Spring Street, Redwood City CA 94063 [tel. (415) 364-5001, FAX (415) 366-3662] and ask for a copy of their free technical manual covering their line of gel cell batteries. This is a very well written treatise covering all aspects of gel cell technology. Power-Sonic is a friendly company and they courteously provided me with a great deal of assistance while I was doing research for my *73* article."

Additional note: Joe modified his program slightly to reflect the factors Frank mentioned, i.e., 1/6 RX vs. 5/6 TX duty cycle. If you assume your TX to RX duty cycle to be very much different from these figures, then you'll want to change Line 100 in the program as mentioned in the REM in Line 95.

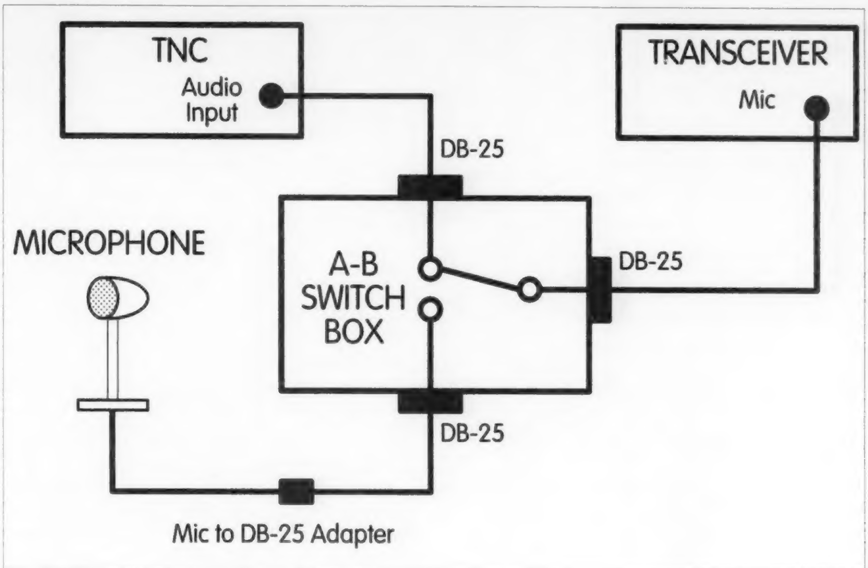

Fig. 2. *VA3DCS's suggestion for using a computer A-B data switch.*

Addition

In addition to being the least expensive of the various battery technologies to manufacture, the SLA (sealed lead-acid) gel cell packs, written about by Joe Gabus and Frank Brumbaugh, are also the easiest for determining how much relative charge is left in them. The reason for this is that the terminal voltage of lead-acid cells drops at a linear and predictable rate, from fully charged to fully discharged, allowing us to simply measure the voltage across the battery to come up with a reasonably accurate estimate of the amount of usable energy left in the battery. When fully charged, a 12-volt SLA battery pack will read an open terminal voltage of 13.08 V (2.18 V per cell). At 50% charge, the 12-volt pack will read 12.54 V (2.09 V per cell), and at 10% charge, a 12-volt pack reads 11.88 V (1.98 V per cell). When charging, the terminal voltage of a 12-volt SLA pack will rise to between 13.8 and 14.4 volts, depending upon the actual output voltage of the charger. (SLA battery packs are best charged with a constant voltage as opposed to a constant current as is the case

```
10 CLS

20 PRINT : PRINT "NAME OF RADIO: "; N$; " LAST COMPUTATION"; X; "HOURS WITH A"; Ah; "AMPERE
BATTERY."

30 PRINT : PRINT : PRINT SPC(25); "GELL CELL COMPUTATION PROGRAM ": PRINT SPC(5); " TO DETER-
MINE OPERATING TIME WITH YOUR RIG, BEFORE RECHARGE IS REQUIRED."

40 PRINT SPC(23); "VER. 1.1 By: Joseph T. Gabus, AB5RE": PRINT

50 PRINT "TEST DATA: 12 Ah BATTERY,  1.5 AMP TX,  0.2 AMP RX  =  40 HOURS OPERATING TIME."

60 PRINT: INPUT "NAME OF RADIO ", N$

70 PRINT : INPUT "AMPERE HOUR GELL CELL BATTERY CAPACITY ", Ah

80 AHR = .05 * Ah: PRINT "CHARGE / DISCHARGE RATE FOR 20 HOURS = "; AHR; " AMPERES/HOUR"

90 PRINT : INPUT "TRANSMITTING AMPERES = ", TA: INPUT "RECEIVE AMPERES = ", RA

95 REM Note that the formula below assumes 50 minutes of RX time and 10 minutes of TX time.
Contest (or other high ratio transmit operations) will require a change to be made to the
formula.

100 AC = (5/6*RA)+(1/6*TA)/2 : PRINT "AVERAGE CURRENT DRAIN PER HOUR = "; AC

105 REM The next 3 lines allow for the use of the accessory(s) of your choice.

110 REM PRINT "ACCESSORY: DSP-40 CURRENT DRAIN = 1.0 AMPERES

115 INPUT "ACCESSORY CURRENT DEMAND IN AMPERES (Default is zero) = ", ACD

120 AC=AC+ACD: PRINT AC; " = AMPERES WITH ACCESSORY."

130 X = Ah/AC

140 PRINT : PRINT SPC(20); "APPROXIMATE OPERATING TIME = "; X; " HOURS."

150 PRINT "HARDCOPY PRINT OUT? <Y/N> "; : INPUT C$

160 IF C$="Y" OR C$="y" THEN LPRINT "RADIO "; B$, C; "AMPERE BATTERY", INT(Y-1);  " HOURS."

170 PRINT "QUIT PROGRAM NOW <Y/N> "; : INPUT A$

180 IF A$="Y" OR A$="y" THEN GOTO 210

190 GOTO 10

200 REM DATA SOURCE: "The Gel Cell Storage Battery" - Frank Brumbaugh, W4LJD, 73 Magazine,
Pages 41-42, February, 1997.

210 END

220 REM Note that your experimental results may differ somewhat. If your radio quits at 72
hours, for instance, and the computed answer was 80 hours of projected operating time, then
change Line 130 to X=(Ah/AC)-8. This adds a bias to the program to compensate for the actual
parameters of your particular Gel Cell battery. Batteries will change Ah capacity with age,
temperature and percentage of charge (time since last recharge).
```

AB5RE's GELCELL.BAS program (see text).

with NiCd and NIMH cells.) As mentioned, this linear terminal voltage drop-off in lead-acid cells (again, unlike NiCd and NIMH cells) makes it quite practical to use an expanded-scale DC voltmeter to measure the relative percentage of charge left in the pack. This

Number 61 on your Feedback card

ON THE GO

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
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Mobile HF Operations

Last month I wrote about some ideas for installing an HF rig for mobile use. While using such a station is not much different than operating a UHF or VHF rig, there are a few key differences. First, a repeat of a cautionary word from last month. Never let your radio operations interfere with the safe operation of your vehicle. I know that seems like basic common sense. It's similar to telling my son Paul N8YDQ to be careful when he goes out. He has no intention of intentionally allowing himself to be injured, but it makes me feel better to say it.

There are two big differences between working a repeater and working the "low bands." First: The frequencies you work are not as clearly defined as with VHF/UHF. Second: There is a desire to log contacts, which normally doesn't exist with contacts made on the local repeater. Each of these, if properly managed, will prove to be little distraction. The trick is to plan ahead.

After playing with various approaches, I made a few decisions that I felt made the operation manageable. First, I decided to pick one band and stick with it for most occasions. I had initially tried working multiple bands, but later decided that approach was not the best. First, this required a multiband antenna which had resonators for five different bands. While to me this looked good, others referred to my vehicle with its 2-meter/440 antenna, cellular antennas and HF array as looking somewhat like "a porcupine in heat."

There were essentially two reasons for my decision to concentrate on one band. First, the multiband needed to be folded over before I could pull into the garage. As I lived in northern Ohio at the time, this meant getting out of the car in rain, snow, etc. The Akron/Cleveland area only gets about 30 days of clear skies each year, so this was more than an academic issue. A single-band antenna with a flexible tip could be pulled over from inside the car by attaching fishing line to the top of the antenna and fastening the other end just above the driver's window. Depending on the car, either a gutter clamp can be used, or if there is no gutter, a magnet can hold the other end of the line. You can open the window, pull on the fishing line, and bend the antenna over on the way into the garage. Even if you forget occasionally, if you have a flexible tip antenna and a spring at the base of the antenna, usually you can expect no damage to the antenna or the garage door.

Second, after trying various bands at various times, I decided that my best overall band to use would be 20 meters. You can still keep several other antennas (and the appropriate wrenches) in the trunk, but personally I prefer to stay on that band. 20 gives you a reasonably good chance at working someone at any time during the day or evening. Besides, it also gives you a good chance at working some interesting DX—if the sunspots cooperate.

Naturally, when working interesting stations you will want to record the information and follow up with a QSL card. Besides, even today a QSL card is still considered the final courtesy of a contact. When working from the ham shack at home, it is easy to log each contact. In a car, whether in traffic or at 70 MPH on the interstate, it may be somewhat trickier. I've tried clipboards on the passenger seat, but found that if I don't look at what I'm writing while I'm writing it, my chance of being able to read it later is marginal at best. I began using a small tape recorder which worked pretty well. The small digital recorders which can attach to the visor make life much easier. If the rig has a digital frequency meter and your car has a visible clock, it is a simple matter to press the record button and dictate the frequency, local time, call sign of the station worked and signal reports without taking your eyes off the road for more than a moment. If you're far from home, you may also want to record your location, particularly if your QSO is with a county hunter.

Many times, rather than trying to find a station that is calling CQ, I'll find a clear frequency merely by feel. I'll glance down at the frequency read out to make sure that I haven't drifted outside the appropriate band, and do the three calls to determine if the frequency is in use. Then I'll call CQ. Maybe it's luck, or maybe it's just coincidence, but I've found that the response I get when calling as a mobile seems to be significantly better than when I call from a fixed location. I guess it's just novel enough to catch other hams' attention. In any case, it's fun to get a better response when using a lower-powered rig and a significantly smaller antenna.

When you have a passenger, sometimes he or she may enjoy hearing you operate, especially if you're talking to someone in an interesting location. This may not only amuse them, but often your passenger will be willing to assist by doing your logging for you. If you're speaking with a US station or one in a country with whom we have a third party traffic agreement, let your guest at least say hello. Who knows? This may be the first step in getting someone interested in becoming a ham.

There are a few things that will help make your HF mobile operations more convenient. Since

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means that an easy-to-build meter, like the one described by Frank Brumbaugh in last month's "Ham To Ham column," can be really helpful in preventing excessive drain-down (see *73*, October 1997).

That's all for this month—be sure to be with us again next month for more worthwhile tips, ideas and suggestions ... ham to ham!

Murphy's Corollary: The test lead on any multimeter will break just before you've finally zeroed-in on the fault that you're troubleshooting. Having to stop and fix the test lead is Murphy's contribution to building your patience and character!

As always, many thanks to those readers who've contributed their time and ideas to this month's column, including:

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Salinas PR 00751

If you're missing any past columns, you can probably find them at *73*'s "Ham To Ham" column home page (with special thanks to Mark Bohnhoff WB9UOM), on the World Wide Web, at: [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73, *and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or* 73 *for any equipment damage or malfunction resulting from information supplied in this column.*

Please send any ideas you would like to see included here to the moderator at the address shown at top. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73*. 73

most speakers on HF rigs are top mounted, they tend to direct the sound up and back under the dash.

An external speaker pointed toward you will improve your ability to hear the other station. You may also want to think seriously about the type of microphone to use. If you have two rigs in the car, I can guarantee that two handheld microphones will manage to get their coiled cords tangled together. This is not something you'll wish to deal with during rush hour traffic. Some people mount a small boom microphone to the left of the driver's visor so it can be positioned in front of the operator. Others like a microphone mounted on a headset; as I've mentioned before, if this is your choice it's best to use a headset with only one earpiece so you can hear sirens, train whistles, etc.

In order to protect my rig from coffee spills, and to make it less visible when the car is parked, I use a piece of cloth that approximates the color of the car's carpeting to cover the rig. A piece of plastic under the cloth gives added protection. For small rigs, disposable shower caps such as those found in hotel rooms work very well, and the elastic edge helps keep them in place.

HF mobile operations is one of the most satisfying aspects of a tremendous hobby. I enjoy adding "mobile" after my call sign on QSL cards and noting where I was when the contact was made. I also enjoy those times when conditions are right, when I get multiple responses to calling CQ as a mobile. It may not be a true pileup, but it's enough to make it extra fun for me. 73

Number 62 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

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One nice thing about this column is that it often reminds me of a multi-level marketing scheme. One item in the column can generate many responses, which leads to more items, and so on. This month, let's see what some of you have responded with.

The material on Gary Johnson's XPWare RTTY software resulted in a note from Larry Winslow WØNFU. He writes:

"I just read your column in the September 1997 issue of *73*. You might not be aware of it, but there is a companion logging program for XPWare called XPLog. The DOS version is currently available on Gary's BBS (where all of Gary's software can also be obtained) and the Windows™ version is about to be released, hopefully by the middle of September."

Gary's software collects logging data and only has the ability to show the previous contact when connecting to a station. He didn't provide any capability to look at all of the data he's been collecting. When I first got a copy of XPCOM (about a year before its first release), I volunteered to write the program to do what his programs don't. After the first release of XPLog, I received quite a few suggestions for expansion of the functionality. Now it is quite extensive including antenna headings, browsing by call/date/name/QTH printing labels and/or log reports, etc. Just as Gary's software is shareware, so is XPLog and the current fee is $20.

Larry, thanks for the reminder. I had seen an earlier version of XPLog, and am glad to hear you are coming out with a new version for Windows. I will look for it on the XPWare site, at: [http://www.goodnet.com/~gjohnson/], as well as try to add it to the RTTY Loop Software Collection.

Another note comes from David M Sundheimer WØNBZ, of Burnsville, Minnesota. Dave writes:

"Twenty years ago I loved to copy press transmissions on my Model 28. I've got some solid state gear now, but I can't find any press frequencies. Can you help? Just point me in the right direction, if you would."

Well, Dave, several times over the last few years I have mentioned the excellent series of books containing press frequencies published by Klingenfuss Publications. Along with a catalog and price list of their books, you will find some sample "hot" frequencies at their Web site, at: [http://ourworld.compuserve.com/homepages/Klingenfuss/]. Check it out. When I did as I was writing this column, there were more than half a dozen stations and frequencies to check out. Of course, you can always get the book, but that's another story!

Another topic which has seen quite a bit of play of late has been the demise of AEA. With many hams owning AEA TUs and TNCs, the potential orphaning of their equipment has resulted in an increased viewing of late night television. Well, now I can direct you to the Web site: [http://www.timewave.com/amprods.html], where the acquisition of AEA by Timewave is described. Timewave has completed the purchase of all the AEA (Advanced Electronic Applications, Inc.) products except the antennas and antenna analyzers. Timewave will offer new product sales as well as warranty service, repair, and firmware upgrades for existing AEA products. I will be in touch with Timewave, and see if they will keep us posted on progress. Otherwise, I would keep an eye on the Web site, if I were you—especially if upgrade or repair information is important.

On a related note, Tempo Research Corp., of Vista, CA has acquired the AEA antenna analyzer and antenna product lines. Contact them directly for information on those lines.

Tom Hoag N6XB dropped me a note, which read:

"Enjoyed your Web site. I am new to RTTY and have just been on the air for a few days. It's lots of fun. I am using the Hamcomm software, and it is working amazingly well. I can copy RTTY below S1, and that's pretty good!

"I also want to check out the BMK Multy software, but I don't know where to get it. Do you have any info on where to get it or where the Web site might be. I would like to compare it with the Hamcomm before I decide which one I want to use."

Tom, I am afraid that the only source I had for the BMK software dried up some time ago, so I am at a loss, too. Best I can do now is put this little note in the column, and hope they call me! They do not, to my knowledge, have a Web site. Good luck, and let me know how things work out.

From out of the past, Ron Kinton came upon this find:

"I have a T.U., with no name on the outside, but inside on the PC board there is the following:

'AFSK-CW 800A copyright 1982 DS 11-15-82 DYNAMIC SPECIALTIES.'

"It is not a kit; it has two areas of diode programming for either CW-ID, or some very short messages; is very elaborate, and has not been built cheaply.

"If you have any knowledge of such a thing, and if you know where I could get a manual, I would like to know. I bought this at an estate sale, so cannot talk to the previous owner. I love RTTY, so would like to fire it up and use it."

Can anyone help Ron? I seem to remember this company from ads years ago, but cannot find anything in my archives. Let me know, and I'll pass it along to him.

GreenKeys

And finally this month, a new service about an old medium. Brian K. Short K7ON announces an Internet mailing list called "GreenKeys." This is a mailing list devoted to the discussion of older radio teletype (RTTY) gear including mechanical teleprinters, terminal units, rolls of paper, gears, cams, wing nuts, paper tape, and anything else related to older RTTY gear.

- TTY Machines
- Teletype Corp History
- Maintenance, Preservation
- Buy, Sell
- Sources of Supplies
- Terminal Units
- Collectors
- Electrical, Electronic, Mechanical

and

Number 63 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
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Shake up the ether

For the last several months, we've been a little off the ham radio topic with our exploration of video technology. This time, let's get back to the shack and look at something closer to home: RF transmitting circuits.

As a ham, you studied long and hard to earn your license. Let's face it, there's basically only one reason why radio should require that kind of certification: You can transmit!

With the privilege of sending electromagnetic waves into the environment comes the necessary responsibility for doing it right. That means not interfering with other services, using only the prescribed bandwidth, and, of course, not hurting anybody.

Back when hams built their own gear, they had to know much more than we do today before they could get a station on the air. For instance, a thorough knowledge of tank (resonant L/C) circuits, among other things, was crucial to avoid transmitter parasitics (non-harmonic, higher frequencies riding on the carrier) and overly wideband operation. Various factors, such as the tank's Q ("quality factor," or ratio of inductance to resistance) had to be taken into account to get things working just right, or all kinds of bugaboos could result. For instance, did you know that a transmitter's output stage can act as a mixer, reacting to signals coming down the antenna wire from other transmitters, *while it's transmitting?* It sounds crazy, but it happens. Perhaps the most common example of it is "intermod" on a repeater.

Lots of hams call darned near any repeater interference "intermod," but true intermod is more than simple interference; it's the result of mixing of the transmitted output with some signal picked up from another transmitter, and it occurs because the interfering signal overloads the output stage, driving it into non-linear operation, thus making it into a mixer. In effect, the repeater transmitter's final amplifier is acting like an overloaded receiver! It takes a lot of signal to do that, but there often is plenty of stray RF up on those hillsides where most repeaters live alongside other powerful transmitters.

These days, anybody with the money for a factory-built radio can get on the air simply by

Continued on page 74

• Anything Else RTTY-Related

This is not intended as a "contest" reflector as this aspect of RTTY is already quite well served.

To join the mailing list, send E-mail as follows:

TO: majordomo@qth.net
SUBJECT:
BODY: subscribe greenkeys

To be removed from the mailing list, send E-mail as follows:

TO: majordomo@qth.net
SUBJECT:
BODY: unsubscribe greenkeys

To post to the mailing list:

TO: greenkeys@qth.net

This reflector is sponsored by Al Waller K3TKJ and is maintained by Brian K7ON. I'll keep an eye on the list, and see if anything of interest appears.

I guess that about brings this edition of RTTY Loop to a close. Remember to check the RTTY Loop Web site at: [http://www2.ari.net/ajr/rtty/].

You can also drop me a note at ajr@ari.net, or even by snailmail at the above address. You can see that I not only read what you write, I actually appreciate it, and use it! So, drop me a note, and we'll see what develops.

Number 64 on your Feedback card

Ham Radio Fun

My Strange QSO

Mysterious voices and guarded messages—a typical Sunday afternoon in the Midwest?

Dave Miller NZ9E
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Niles IL 60714-3108

It was a cold gray Sunday afternoon, one of those winter afternoons when everyone in the northern latitudes is content to stay indoors. I had finished talking with a friend in the South Pacific on 15 meters, a schedule that we tried to keep each Sunday afternoon. The band seemed to be exceptionally quiet; not many other stations anywhere on 15. I wondered briefly, but thought oh, well, count your blessings—at least there was no QRM, and signals between the South Pacific and Chicago were very readable. My friend and I'd had an enjoyable QSO. We had often joked about there being an ionospheric pipeline between our homes 6,000 miles apart, we enjoyed Q5 signals so often. We had just signed with each other when I heard another station calling on the frequency that we'd been using. He must be calling Brian, I recall thinking, no one ever calls 9-land for a DX contact!

I listened for a few seconds, just for fun, to see who was calling him. Then I heard it: "This is Alpha Charlie One calling NZ9E. Over."

Alpha Charlie One? I kept listening, not really knowing how to reply. My DX friend didn't come back to the mystery station either.

"This is Alpha Charlie One calling NZ9E, do you read me? Over."

No mistaking it this time. He'd said "Alpha Charlie One" and my correct call. I remembered from studying the FCC rules and regs that it was illegal for licensed hams to talk with unlicensed bootleggers, and this sure seemed to fit that bill! I hesitated again, but the same call was repeated once more:

"This is Alpha Charlie One calling NZ9E, do you read me? Over."

Curiosity finally got the best of me. I keyed my transmitter and returned with "Alpha Charlie One, I think you said, this is NZ9E. Are you a ham operator?"

"No," was the reply, "I'm with the US military in **** (Central America). How do you copy me? Over."

> ***"Are you sure you're supposed to be on this frequency?"***

The US military? Why was he calling me? "Yes, I'm copying you well enough," I responded. "Are you sure you're supposed to be on this frequency? This is the 15-meter amateur radio band."

"It'll be okay," he said, "I need someone to pass on a message for me to my headquarters in the states. Can you do it? Over."

I felt that I was getting in too deeply at this point—perhaps I should have just ignored his call in the first place. But then, maybe it would be wrong to just throw the big switch and leave now. Trying to think this out on the run, and not leave too long a pause between his transmission and mine, I answered, "This is NZ9E. I don't know, are you *sure* that this is okay?"

He came back with "It's okay—I can't make contact to the states on my normal radio channels. That's what I want you to pass along. Will you help me? Over."

I've never cared much for that "over" business—sounds too military or too Hollywood, but since he was used to it, I decided to comply. "You want to me contact someone here? Aah, over," I said.

"Yes, I'd like to have you place a phone call to my base commander and give him a message, over."

"Well, all right, give me the phone number and the message," I told him.

He gave me the number to call and asked me to tell them that the nighttime frequency was not getting through, but to use the daytime frequency instead; that he would be listening on the daytime frequency beginning that evening.

"Who am I calling and where are they located?" I asked.

"Can't tell you that," he said, "but promise that you won't stop trying to get through until you've passed the message personally," and he gave me the name of the colonel with whom I was supposed to make personal contact.

Great, I thought, now I don't even know what I'm passing along or exactly to whom!

"Can you promise me that? Over."

"I suppose," I answered. "You're *sure* this is legal? Over."

"It's okay," he reassured me once more, "but please assure me that you'll get through no matter how long it takes."

"Yes, yes I will," I promised. What else could I do at this point? "Alpha Charlie One (what am I doing using this goofy call?), this is NZ9E, I'll pass the message for you, QSL? …errrr rather, do you copy? Over."

"Yes, I do, NZ9E, and thanks a lot for your help. It's important. Alpha Charlie One clear."

"Right, understand, NZ9E is also clear."

I sat way back in my chair and stared at my rig for several minutes—what had I promised to do?

I turned off the gear and walked slowly upstairs, still not quite sure what had happened or how I'd managed to get involved. I wondered if my friend in the South Pacific had heard any of that exchange. We didn't have another schedule until the following weekend, so I couldn't even ask him what he had thought of all of that. It looked like I was on my own on this one.

I found my wife Sue (KA9UCK) in the living room reading the Sunday paper. She asked me how my schedule went.

I told her, "Fine, Brian says hi," then I told her about the strange ending to our QSO.

She asked me what I was planning to do. I told her I wasn't quite sure yet, I was still a bit confused from the unusual conversation. She said I'd have to pass along the message—I had promised I would. I agreed, but also brought up the fact that I wasn't sure how legal it all was—was this guy really US military or some terrorist or drug runner—or? Too much TV and too many spy movies, I suppose.

"Is there anyone you can call and talk to about this first?" she asked.

"Like who?" I said almost absent-mindedly.

"How about the FCC?" she offered.

"What if what I did was illegal?" I countered.

"Well, it wasn't like you did something illegal on purpose," she reasoned. "You couldn't just ignore the call, could you?"

"No, I suppose not," I said, "but how is the FCC going to know if this fellow was on the up and up or not? I don't even know."

We talked about it some more and she convinced me that I should keep my word, but also report any suspicions that I might have to the authorities.

I thought a lot about that through the rest of the day. I also called the number that Alpha Charlie One had given me, but the phone rang and rang with no reply. I was actually relieved. I didn't really *want* anyone to answer.

The next day, Monday, I woke up still thinking about the previous afternoon. I had pretty much decided what to do.

I was going to call the FBI and see what they thought about it—pass the buck, so to speak. I had been part of a TV crew that had done a piece on the Chicago FBI office a year or two before this incident, so I thought I'd feel reasonably comfortable talking to one of their agents. They were pretty nice guys, the ones I'd met while taping the show. I would tell them my suspicions—Central America, drugs, terrorists, guerrillas, etc.—and see what they advised me to do. Good plan; that's what I'd do. After all, the radio signals crossed state lines—heck, international boundaries! Maybe I should call the CIA instead? No, the FBI had been in less hot water—so the FBI it was.

About 10 a.m. I telephoned directory assistance and was given the telephone number for the FBI's Chicago office. Nervous, and not wanting to come across as a kook or crackpot, I dialed the number. I'm getting in too deeply, I kept thinking. I managed to convince the receptionist that I was a concerned citizen and felt that I should speak to a special agent. That's what they call themselves, Special Agents. I learned at least that much about the FBI during the TV piece we did! She eventually put me through. I told the agent that I was an amateur radio operator and briefed him on what had transpired during my conversation with Alpha Charlie One the day before. He was a really nice chap and he even understood something about ham radio. He seemed to know that I wasn't off my rocker, but rather that I was genuinely concerned about not aiding and abetting anything contrary to our country's international position. He told me that he knew of no reason why I shouldn't make the call as requested (nothing was particularly sensitive in that Central American country right at that time), but he asked me to pay close attention to everything said during the conversation with the party that I was asked to call, then call him back and let him know how it went. I thanked him for his help and advice, and we hung up.

Yes! (One of those yeses that kids use today when they feel they've accomplished something worthwhile or passed the buck!) It seemed like maybe I was off the hook! As long as I had the FBI on my side, could I wander too far astray? I called the number given me by Alpha Charlie One with renewed confidence.

You know how sometimes you'll hear switching transients when your phone call is routed through a complex internal network? Well, it seemed like I was taking the long way to Mars on this call! Switching pulse after switching pulse … it went on for at least half a minute. Where the heck was I calling? Finally a female voice. She spoke so fast that I'm not actually sure what she said, but it sounded governmental—maybe even military! After explaining everything to her in excruciating detail, she said that she would take the message and pass it on. I told her that I had promised the sender that I would give the message to the colonel personally, and that I felt that I was morally obligated to do that. She was reluctant, but handed my call off to someone else. Don't you love when that happens? Another complete explanation, I still wasn't talking to the named colonel, but maybe I was getting closer. Fade back for a pass; pass received. I found myself talking to still another unrecognizable name, still not the colonel, but still getting closer! One more pass and reception and I was at least in the colonel's office, apparently talking to his secretary. It was getting harder and harder to gain yardage the deeper I got into the maze, but I was finally able to break through their defense line and go for the touchdown. I was over the goal line, finally talking to the colonel himself! Great! Just one more complete explanation!

He asked me lots and lots of questions, most of which I couldn't answer—such as why did this Charlie Alpha One call me?

I didn't know, of course; I supposed it was simply because I was there, on frequency, and I was the only one he heard at that time. Lucky me! The colonel was very reserved as to what information he was willing to give me to satisfy my own curiosity, and I was cool enough not to ask too many questions, but I knew that he was relieved to receive the message. Obviously, he knew who Charlie Alpha One was (though he never actually said so!). At the end of this rather strained conversation (from my standpoint), he asked me if Charlie Alpha One had told me anything more about his mission. I said "No."

The colonel said "Good!" He thanked me for calling and we hung up. I called back the FBI agent I had spoken with earlier, as promised, and told him what had transpired. He said that he was satisfied that it was nothing for me to be concerned about any further, thanked me and hung up.

The following Sunday afternoon, I asked Brian (my DX friend) what he thought about my strange QSO with the Charlie Alpha One? He hadn't listened—he'd tuned off the frequency when he heard that the call was for me. The Charlie Alpha One call hadn't really registered with him at the time either.

So that's pretty much the whole story … at least as much of it as I feel free to tell. I've only held back on some of the specific identification details. To this day I've never heard any more from anyone involved. Not even a QSL card! I watched the news more intently in the following weeks, but never saw anything that might have been even remotely connected with my strange QSO. I doubt that I'll ever know the whole story, but maybe that's for the best. It's more fun to imagine what it might have been all about. Who says there's no adventure left in ham radio? I doubt that the Internet could match it!

Postscript

In a later conversation with another ham friend, one who had been in the communications branch of the military, I was reminded that all of the frequencies (including our beloved ham bands) actually belong to the DOD, the Department of Defense. The DOD loans the frequencies out to the FCC to dispense to the civilian population during times of peace, but they're still DOD's when needed in an emergency. It makes sense: What's more important than defending our country and keeping America free? 73

RF Voltage and Power Meter

Going up? In power, that is? Find out with this easy-to-build instrument.

Randy Henderson WI5W
10809 NE 17th Street
Oklahoma City OK 73141

I'm sure you want to communicate effectively to get the most enjoyment out of your hobby. Whether you are using QRP power levels (under five watts) or the legal limit, measuring the output power of your transmitting equipment provides some assurance that your signal has a good start in overcoming the vagaries of propagation.

Many stations don't have instruments capable of indicating forward and reflected power at the same time. Build this project and you can use your present SWR meter to continuously indicate reflected power while this one reads forward power. With a little care, you can make it capable of accurately indicating output power, too.

A roundabout method

Most amateurs use instruments which measure power indirectly—current in the transmission line is often the quantity being measured. If the indicating device is a meter, the scale will be calibrated in watts instead of amperes.

This is possible as long as the load resistance is known. It is usually assumed to be 50 to 52 Ω. Whether the measuring circuit is in your rig or in an external unit, this technique is usually implemented in a way convenient for measuring reflected power.

In addition to requiring more complicated construction, the usual method uses some type of transmission-line transformer or current transformer which will only work at radio frequencies. An accurate source of RF power at various levels is necessary to calibrate such instruments.

The measuring system shown here can be calibrated with an inexpensive DC voltage source. You can probably find many of the components in your junk box. It is an easy and inexpensive project. For accurate power measurements, the load seen by the transmitter must be a known value (as is also the case with current-based measurements).

Because peak RF voltage is being measured, you can connect a source of known DC voltage for calibration purposes to this circuit without the customary 50 Ω load. It is not necessary to send large amounts of power to the load. A voltage reading is just as valid when taken across a low-power (high-resistance) load as when read across a high-power (low-resistance) load.

If we are talking about DC circuits, power is related to voltage and resistance by **Equation 1**: $P = E^2/R$.

Power (P) is equal to the voltage (E) squared divided by the resistance (R).

The basic units for this relationship are watts, volts, and ohms.

We can also use this relationship with RF voltages. Your transmitting equipment will produce an output signal with a sine wave shape. It does not contain the same amount of power as a DC signal with the same peak voltage. To convert the peak RF voltage to a value equivalent to DC of the same power level, multiply it by 0.707.

The reason for discussing peak voltage is because a simple rectifier circuit can be used to detect the peak voltage of the RF waveform. The schematic in **Fig. 1** shows how the transmitter output voltage is reduced by a voltage divider made of R1 and R2 before being rectified by diode D1.

Reducing the voltage applied to the diode is necessary because it would be destroyed by high-power operation if connected directly to the transmission line. Diodes capable of withstanding high voltage have relatively slow switching speeds and other characteristics which make them unsuitable for this application.

Pesky parasites

Unfortunately, parasitic capacitances can cause the response of this circuit to vary when used over a wide frequency range such as 1.8 to 30 MHz. This effect is represented by Cp and Cp′. These are not actual components. They represent the capacitances that exist between various parts such as component bodies, leads, the diode junction, and the enclosure.

Often, Cp′ will be large enough to reduce sensitivity as the frequency is increased with all other factors being constant. You can, however, correct this shortcoming by using the correct value for Cp.

In **Photo A**, the parasitic capacitance Cp is increased because the ends of R1 are brought close to each other. R1 is actually made of 4 resistors for increased power rating. Two parallel resistors are in series with two other parallel resistors, all being of the same value.

Final adjustment is made by bending leads of the resistor bodies composing R1 farther from or closer to the enclosure bottom formed by the copperclad board. This effectively adjusts Cp′.

Another way to adjust for a flat frequency response is to make Cp variable. You can do this by soldering a short pigtail to the input end of R1. To increase Cp, bend the end of this lead closer to the opposite end of R1.

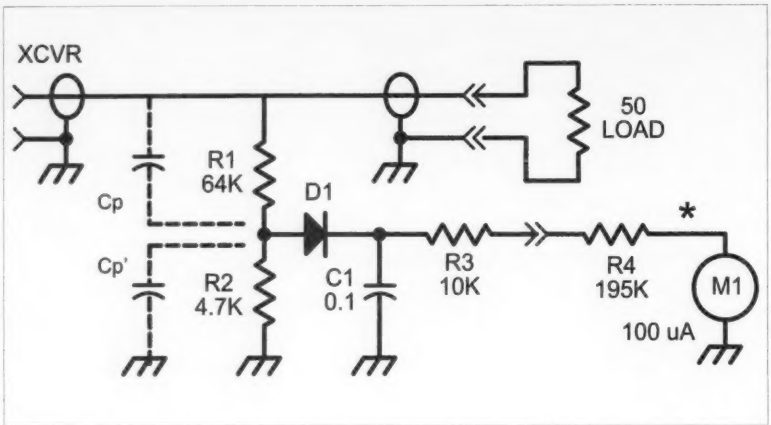

*Fig. 1. Four half-watt resistors make up R1. R2 is 1/4 W or larger. *R4 can consist of several individual resistors in series or series/parallel combination to achieve the required value. Another possibility is to use a fixed resistor and a variable one. In this example, a 180 kΩ resistor in series with a 30 kΩ pot could be used. D1 is a 1N34A (available at Radio Shack™).*

One alternative for alleviating the effects of parasitic capacitance is to use much smaller values for R1 and R2. If R1 and R2 have much lower resistance values, perhaps by a factor of 10, the reactance caused by parasitic capacitance is relatively inconsequential at HF. Unfortunately, power dissipated by the resistors will be much greater. At an RF output level of 1000 W into a 50 Ω load, R1 and R2 in **Fig. 1** would dissipate more than 7 W total if their values were reduced this much. Other complications such as parasitic inductance and unwanted inductive coupling can also enter the picture if you choose this route.

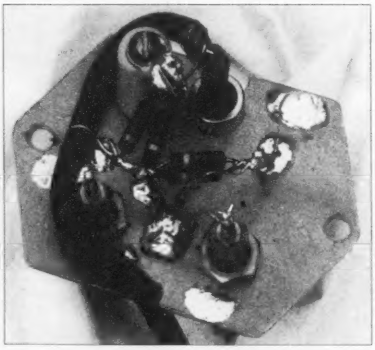

***Photo A.** R2 is hard to see in this photo, but it is soldered to the ground plane. R1 consists of the four 1/2 W resistors, with two of them connected to the solder lug atop the cone-shaped ceramic insulator. A small square of copperclad board is cemented to the ground plane and supports the junction of D1, C1, and R3. A short piece of hookup wire soldered to the ground plane secures the RG-58 cable.*

To find out if the circuit has a flat frequency response over the intended range, you need an RF signal source and some method of ensuring that signal levels are the same at both ends of the range.

For a flat response from 1.8 to 30 MHz, you need only a relative reading at both frequencies. An absolute reading is not necessary at this point. Just make sure the two readings are equal.

Wait a minute: If you already have a power meter, why build another one? One reason is that you can use your existing gear to help calibrate an instrument capable of making reasonably accurate measurements at higher power levels.

Suppose you have a 100 W rig and decide to acquire an amplifier. Older amps and home-built ones may not have an absolute indication for power output or you may need something such as this project as a standard. Similar problems may exist for amplifiers made to boost QRP rigs to higher output levels.

In the above case, you could use an HF transceiver as the source as long as you have a power meter (calibrated or relative, internal or external) with a flat frequency response. Most power metering circuits will have a relatively flat response. Some instruments commonly known as "Monimatches" are made for measuring only SWR. They have a rapidly increasing response with increasing frequency, and are not suitable for this particular test. If you're not sure, you can modify **Fig. 1** to use it for this purpose.

To modify **Fig. 1** for testing the high- and low-frequency signals of your source, simply solder a short wire jumper across R1. The circuit is now suitable for measuring outputs of up to about 25 W. Use this arrangement to test or adjust your RF source to ensure that equal power levels are obtained at both test frequencies. This is possible because the reactance caused by parasitic capacitance Cp′ is negligible compared to the 50 Ω load.

If the RF source is difficult to do this with because of varying output levels, you could make a temporary or even permanent version of this modified circuit for low-power testing. Leave it connected to the load as you test and adjust the high-power RF voltmeter for a flat frequency response.

I used a 100 μA meter movement for M1. When you are adjusting Cp′ by positioning resistors, temporarily use a value for R4 that provides a deflection of at least half-scale or more for M1. Small changes in response will be easier to read in this way.

Suppose the power level when adjusting Cp′ is 20 W. This would correspond to a peak voltage of approximately 44.7 V. For a full-scale meter indication at 50 V peak, the total resistance of D1, R2, R3, R4, and the meter movement should equal 500 kΩ.

Alternatively, you can use a multimeter set at the appropriate voltage scale in place of M1. Analog multimeters are fine for this purpose and digital ones are even better. Remember to test with any cover in place over the rectifier circuit because it will affect Cp′.

Once you have the rectifier circuit set up for a flat frequency response, it can be calibrated to measure actual power levels. As I mentioned previously, you can use a dedicated meter movement or use a multimeter connected at R3.

A double-checking doubler

My RF voltage/power meter is calibrated for a full-scale reading at 1000W. This means that it is at full-scale deflection (the 100μA indication) at 316.4 peak RF volts as well as DC volts. I used the AC-powered voltage doubler in **Fig. 2** constructed breadboard style to adjust R4 for the proper reading. Actually, you can calculate the value needed for R4 using Ohm's Law and Equation #2. However, this procedure helps double check the results in the event component tolerances cause errors.

Do not connect the 50 Ω dummy load for this part of the test. The little voltage doubler is not designed to supply 2000 W to the dummy load!

The voltage divider composed of R1 and R2 in **Fig. 1** will reduce 316.4 V to about 21.65 V. With the additional 100 μA current drawn by the meter movement, it will be reduced even more to about 21.2 V. For a full-scale reading at 100 μA with 316.4 V, the total resistance of D1, R3, R4, and M1 should be 212 kΩ. Actually, it may have to be slightly lower because of individual diode characteristics. The meter current in **Fig. 1** causes the circuit to be a less-than-perfect peak detector.

In the event that you simply haul some parts out of the junk box to construct this circuit, the calibration procedure is a pretty good way to make up for imprecision in several areas. This is the reason R1 was 64 kΩ in the prototype (a nonstandard value) instead of 62 or 68 kΩ. The resistor tolerances were rather wide.

Alternatively, using precision 1% resistors will yield reasonably good results if you don't have a means of making very accurate resistance or high-voltage (DC) measurements and M1 itself is accurate. Calculating the voltage at the top of R2 is easy as long as you don't have to contend with the meter current. Adding the meter current complicates things because the voltage divider is now altered. To calculate the voltage across R1 use **Equation 2**: $E1 = [(Et \times R1) + (Ib \times R2 \times R1)]/R2 + R1$.

E1 is the voltage across R1. E2 is the voltage across R2. Ib is the meter current. Et is the total voltage across the resistor string—in other words, at the transmission line. Finding the voltage across R2 is simply a matter of subtracting E1 from the total voltage, as in **Equation 3**: $E2 = Et - E1$.

Fig. 3 is a simplified representation of **Fig. 1**. There are effectively only three current paths for the rectifier circuit in this project: Ia, Ib, and It. Yes, a current path exists through the dummy load. It loads the voltage source for the transmission line, but otherwise has no effect once you know the transmission-line voltage.

Rm represents the total resistance in the series path supplying meter M1. Analog D'Arsonval-type movements may have a resistance of several hundred to maybe 3,000 Ω. Most digital voltmeters have an input resistance of 10

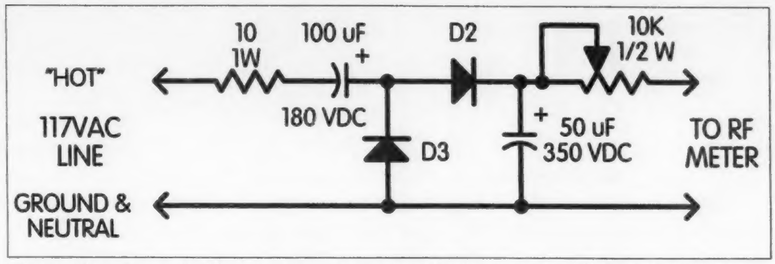

Fig. 2. This voltage doubler circuit can be used to check calibration of the RF voltage/power meter. D2 and D3 can be a 1N4005, 1N4006, or 1N4007. Adjust the variable resistor for 316.4 V at the transmission-line terminals if you want to simulate the peak voltage of a 1 kW sine wave into a 50 Ω load. Component values are not critical. Just be sure to use voltage and power ratings at least as high as those listed and use extreme caution with the high voltage.

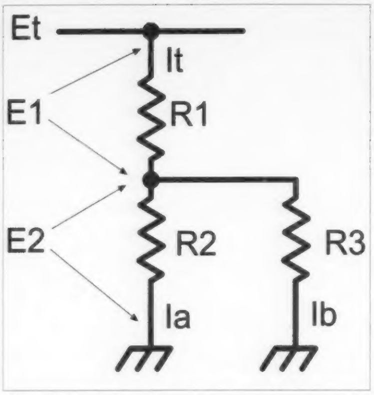

Fig. 3. Most of the problem in determining E1 involves finding the current in R1 by substituting equivalent expressions for It.

megohms. If you use a digital voltmeter, that is high enough to treat R1 and R2 as a simple voltage divider instead of using **Equation 2**.

The current path through R2 is represented as Ia and current in Rm (the meter circuit) is Ib. These currents are combined in R1 as It. After finding E1, E2 is the difference between Et and E1, so you can simply divide E2 by Ib to find Rm.

I mounted all of the rectifier circuitry on a small piece of copperclad board. This includes a PL-259 plug and two binding posts for attaching the meter leads in **Photo B**. The PL-259 plug is mounted by tightening an RG-58 cable adapter against the board after inserting it into a slot cut for this purpose.

Referring back to **Photo A**, the connection between R1 and the transmission line is made very close to the PL-259 by carefully splitting the coax. The shield braid is left intact. A Mouser stamped steel box serves as a cover.

The meter movement is housed in a painted wooden box. **Photo C** shows how everything is assembled, with the RF rectifier assembly connected to a dummy antenna.

I usually use it to monitor output continuously by screwing it directly onto the output of the SWR meter that goes to the antenna system. If the SWR reading is close to 1:1, the power reading should be reasonably accurate.

If, however, several feet of coaxial-cable jumper separate your SWR (reflected power) meter and rectifier assembly, the RF voltage/power meter could be indicating a voltage developed across something other than 50 Ω. This is especially true with some antenna systems on the higher bands.

Some summation

Don't get lost in the details. They are here to provide options. If you don't want to (or can't) adapt the circuit to your individual requirements with one method, perhaps another will work.

To recap, the main idea is to make a resistive voltage divider which feeds an RF-voltmeter circuit. We compensate for parasitic capacitance to make sure the voltage divider has a flat frequency response across the desired frequency range.

Next, we set up the meter circuit so that it reads full scale at a voltage

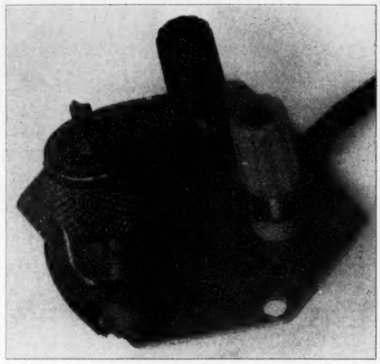

Photo B. *A PL-259 connector and two binding posts allow convenient connections to the load and meter leads.*

corresponding to the peak voltage of an RF sine wave at a chosen power level. In this example, the level is 1000 W, although lots of other power levels could be chosen. You might pick 150 or 1500 W.

You can design the meter circuit empirically by testing its response to an accurately set voltage (RF or DC), or carefully compute and select resistor values to use with an accurate meter movement or DVM.

Even relative measurements are quite useful if you end up with less than accurate results. I can remember occasions when I was blissfully unaware that the low SWR reading was *not* because of a well-matched antenna system (dead mike, keying with drive turned down, etc.).

This RF voltage/power meter has proven to be a valuable addition to my shack for both testing and general operating. You'll benefit from yours, too!

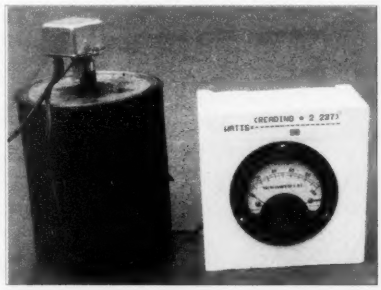

Photo C. *The meter can be placed at a convenient distance from the rectifier circuit. The legend on the meter box which reads "WATTS = (READING x 2.237)^2/50," results in the following correlations: 10 μA = 10 W; 20 μA = 40 W; 40 μA = 160 W; 80 μA = 640 W; and full scale = 100 μA = 1000 W. RMS voltage equals 2.237 multiplied by the reading. The box covering the rectifier assembly is a Mouser #537-MO18-PLTD.*

NEVER SAY DIE

Continued from page 45

look over my guide to books you're crazy if you don't read—there are several excellent ones on raising children. Like *The Prenatal Classroom*, which explains how you can teach your child around 100 words before it's born, thus giving it a substantial head start in learning. And how you can instill a love of good music, too.

Magnets

I presume that despite my reviewing two books on magnetism in my editorials, and then including them in my guide to *Books You're Crazy if You Don't Read*, that you haven't bothered to do any homework on magnetism.

The Rawles and Davis book, *The Magnetic Effect*, published over 20 years ago, cites many experiments where seeds were put over the north and south poles of magnets. Seeds exposed to the north pole energy grew slower, developed thinner plants and poor fruits and vegetables. South pole energy resulted in vigorous growth and bigger, sweeter fruit.

It turns out (surprise!) that magnets have a similar effect on humans and animals. A good friend of mine, who is an expert on magnets, visited recently and when Sherry had a sore knee and elbow from bursitis, taped two small magnets to the affected areas when she went to bed. The next morning the pain and swellings were gone and haven't come back!

By the way, when it comes to plant growth, you can have a profound effect on the growth of seeds and plants by either loving or hating them. If you tell some seeds that they are no good, that they are ugly and never will be any good, you'll get slow growing, stunted plants. If you tell them what fantastic seeds they are, that they are going to grow high and strong and produce beautiful flowers or vegetables, you'll get just that.

Hey, read *Secrets of the Soil*, it's in my guide! Music helps plant growth too.

Continued on page 79

Variable Current Load Bank

A bright idea for testing power supply parameters.

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Few of us would tempt fate by playing Russian roulette with a loaded revolver, but we play a similar game of chance with our solid-state rigs when we connect them to untested power supplies. Simply measuring the unloaded output voltage of a power supply is not enough. The sharp drop or rise of output voltage from a poorly regulated supply can cause serious damage to equipment operating from it.

This article describes a simple, inexpensive load bank—along with a brief discussion of power supply tests and measurements—for performing confidence tests on power supplies *before* connecting them to your equipment. The scope of this article is limited to 12V to 15V DC power supplies, and to tests that require a minimum of test equipment.

Most amateur power supplies can be checked quite effectively using three simple tests: load regulation, line regulation, and ripple.

Load regulation

Testing load regulation and ripple involves supplying a calibrated load to the power supply. While a simple load bank can be built using an assortment of high wattage, low resistance resistors or rheostats, there is also a simple junk box solution (for 12V to 15V supplies)—use automobile lamps. They are available at any auto supply store or service station, cheap, easily replaced, and come in a wide assortment of power ratings.

Fig. 1 illustrates a simple load bank using readily available automobile brake/stop lamps. While only three lamps are shown, more can be added as needed. The lamps selected have two filaments in each envelope. One requires 0.6 amps (this is the tail lamp element) and the other 1.8 amps (the brake light element). As shown, the load bank will supply loads of 0.6 to 7.2 amps in twelve 0.6-amp steps (see **Table 1**).

There are some trade-offs when using lamps for loads. The first is that an incandescent lamp has a positive temperature coefficient (its resistance increases with heat). Therefore, when voltage is first applied there is a great inrush of current because of the low resistance, but the filaments heat up quickly and the power supply should tolerate this low duty cycle overload.

However, some industrial power supplies incorporating crowbar protection may respond to the rapid inrush of current as indicating a short circuit, and they will shut down the output to protect the supply. It is my personal opinion that such power supplies are not suitable for amateur use because of the rapid and heavy current demands of CW operation. And in this sense, the lamps provide a rigorous test for just such operation.

The second problem is the very bright light developed by the lamps' doing what they were designed to do. This

Load Switch Settings

Switch	#1	#2	#3	#4	#5	#6	
Current (A)	0.6	0.6	0.6	1.8	1.8	1.8	Total Current
	1	0	0	0	0	0	0.6A
	1	1	0	0	0	0	1.2A
	0	0	0	1	0	0	1.8A
	1	0	0	1	0	0	2.4A
	1	1	0	1	0	0	3.0A
	0	0	0	1	1	0	3.6
	1	0	0	1	1	0	4.2A
	1	1	0	1	1	0	4.8A
	0	0	0	1	1	1	5.4A
	1	0	0	1	1	1	6.0A
	1	1	0	1	1	1	6.6A
	1	1	1	1	1	1	7.2A

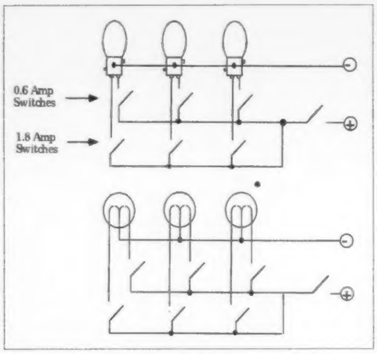

Fig. 1. Diagram and schematic.

problem can be managed by placing the load bank out of direct view, or wearing sunglasses, etc. But there's even a plus to the light situation: You *know* when the lamps are loading the power supply, even without an ammeter in the line.

Let's define the measurements we will be making. Load regulation deals with the change in output voltage from a no load to full load situation (and expressed in percentage of change). A power supply suitable for amateur use should regulate to within at least 10%. For example, if a power supply delivers 14 volts without a load, and drops to 12.6 volts while supplying full output current, the regulation (as a percentage) would be calculated as follows:

% Voltage Regulation = 1 - (FL/NL) x 100

where

NL = Voltage output with no load
FL = Voltage output while supplying full load

thus
% Voltage Regulation = 1 - (12.6/14) x 100
% Voltage Regulation = 10

Line regulation

Line regulation deals with the change in output voltage with a change in line voltage (generally ±10% change in AC input). This measurement is generally performed with the supply delivering maximum rated output current. A power supply suitable for amateur use should line regulate to within 5% or better. For example, if a power supply delivers 12.6 volts at full output current with the line voltage set to 132 volts AC, and delivers 12.0 volts at full output current with the line voltage set to 108 volts AC, the line regulation would be calculated as follows:

% Voltage Regulation = 1 - (LL/HL) x 100

where
LL = Voltage output at full load with line voltage set to 108V AC
HL = Voltage output at full load with line voltage set to 132V AC

thus
% Voltage Regulation = 1 - (12.0/12.6) x 100
% Voltage Regulation = 4.8

Ripple

Ripple (or hum) is measured at full output load and generally expressed in AC millivolts. The less ripple the better! Even for amateur use, the ripple reading should be less than 0.5%. For example, a power supply delivers 12 volts DC at full load and its ripple measures 60 mV rms. Although this is 0.5% of the output voltage, 60 mV can cause a lot of grief around high-gain audio amplifiers (and especially direct conversion receivers!). *Important:* If the power supply being tested is a switching type, a minimum load must always be applied or it will not function. Therefore, the regulation test should be from *minimum* load to full load.

"The less ripple, the better!"

A typical test setup for performing load and ripple measurements is shown in **Fig. 3**. Notice that the digital voltmeter is connected directly to the power supply terminals for maximum accuracy because of copper losses in the test setup wiring. Determining the load burden based upon **Table 1** will be close enough for most applications. However, if you use the lamp load bank to test lower voltage power supplies (such as 5V or 9V units), an ammeter should be used.

Another thing to keep in mind is that regulation specifications interact. For example, varying line voltage (perhaps from a portable AC generator during Field Day, or a long extension cord, etc.), combined with the load regulation, can result in severe regulation swings. And, of course, take into account the copper losses of the cable from the rig to the power supply and the resistance of inline connectors. You should either minimize all of these factors, or hope you never experience a worst case event!

While there are a lot of other meaningful power supply specifications (such as recovery time, regulation overshoot, etc.), simple regulation and ripple tests are adequate for most amateur applications.

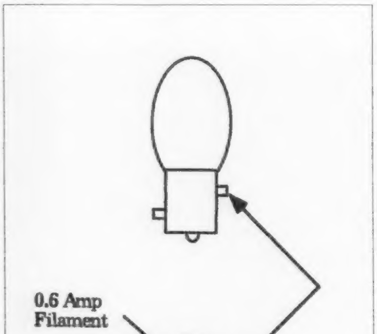

Fig. 2. Type 1034 pinout.

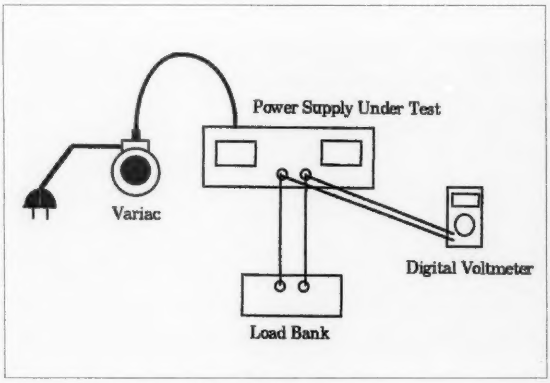

Fig. 3. Regulation/ripple test setup.

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KABOOM

Continued from page 63

stringing a dipole in the trees. There's nothing wrong with that, but it's led to a near loss of the "art" element of radio. The days of fiddling with vacuum tube neutralization and such are pretty much over. So, in the interest of keeping the art of radio going, this month, I thought it would be fun to explore transmitters and their quirks.

In the beginning

Before you can send a signal out from your antenna, you have to make one. A signal, that is; I'm assuming you already have the antenna! How the RF is generated varies greatly by the type of RF you want to make. FM, AM, SSB, CW, VHF and UHF all have different methods of generation. To generalize, though, the process requires one or more oscillators, a modulator of some kind and an amplifier or two.

CW

It's easy to generate RF using a one-stage oscillator, and zillions of transmitters have been made that way. In fact, with tubes, it wasn't hard to get a few watts right out of the oscillator, with no further stages of amplification needed. Back when CW was the dominant mode, all it took was a key, a few coils, resistors and capacitors, one tube and a way to power it, and you were on the air! Even in the modern, solid-state age, single-stage transmitters are still being built by QRP enthusiasts. Most transistor oscillators don't put out much power, though, so a lot of QRP rigs employ a stage or two of amplification before the antenna.

To generate CW, all one has to do is key the oscillator on and off. Well, sort of. Such crude keying works decently only when the oscillator is very stable. If it isn't, it'll "chirp," or slide in frequency as the power goes on and off. Most crystal oscillators can tolerate power keying, but even some of those get ugly with that method. A far better way to key a CW transmitter is to leave the oscillator running and key an amplifier stage following it. That lets you tailor the keying curve to avoid "key clicks," which are unwanted sidebands caused by the rapid transitions of the key's on and off states. A capacitor or two can easily damp key clicks by "softening" the transitions (slowing them down), but such softening plays havoc with oscillators, so it's rarely used in single-stage designs which key the power going to the oscillator. Now and then, you can get away with it when the oscillator is crystal-controlled.

In a modern multistage radio, keying is much more complex than a simple on/off signal. A typical HF rig has a pretty involved keying circuit which sequences various operations each time you press the key. First, the synthesizer's VFO is put on the correct frequency. Remember, it could be a few hundred hertz off (due to the receiving offset), or it could even be on another band if you're operating split. Once the transmitter is on frequency, the antenna changeover relay (if there is one) is set to connect the transmitter to the antenna, rather than the receiver. The receiver is muted at about the same time. Finally, the RF is applied to the final amplifier and out it goes. Whew! Of course, all this happens very fast, and all you really experience is pressing the key and sending the dit or dah. Still, without this kind of sequencing, things we take for granted, like full break-in and split-frequency operation, wouldn't be possible.

"With tubes, it wasn't hard to get a few watts right out of the oscillator."

The final amplifier itself doesn't have to be linear to make proper CW. In other words, it can clip and have all kinds of ugly distortion, because all that matters is whether the carrier is on or off; it conveys no other modulation. Why do it that way? Well, it's cheaper and simpler to make a non-linear, or "class C," amplifier, and such a stage is much more efficient than a linear one, too. To make it work, all that's required is a good low-pass filter before the antenna. Remember, all the ugly stuff is at a much higher frequency than the carrier, so filtering out everything above the desired carrier will leave nice clean sine waves, no matter what the waveform originally looked like. In fact, that's how it's done in virtually all CW-only transmitters.

AM

Next up the evolutionary modulation scale is AM. This mode shares more with CW than you might imagine! Basically, it's a steady carrier which has its strength, or amplitude, moving in step with the audio (or data, or whatever) you wish it to carry. The actual waveform is spectrally more complex than that, but the method of generation really is that simple. Since the carrier's strength must track the modulation, that would suggest a linear amplifier stage for the output. Certainly, you can do it that way, but you don't have to! In fact, AM can be generated using a CW-style, class C amplifier. All you have to do is feed a steady, unmodulated carrier to the final amplifier, just as you would with CW. The trick is to modulate the final amp's DC power input with the audio itself! As the final amp's power goes up and down, it'll turn that steady carrier into good ol' double-sideband AM. The downside is that you need about 50% as much audio power as RF power. So, for a 10-watt AM transmitter, you need a five-watt audio amplifier. Despite that power-hungry inconvenience, most AM transmitters work that way, including all the AM-only CB sets I've ever seen. It's just cheaper and easier to make audio power than linear RF power. Besides, much of the inefficiency of needing all that audio power is made up for by the efficiency of the class C final RF stage.

FM

In FM, the modulation is impressed on the carrier by wiggling its frequency around a little bit. There's no way to do that once the carrier is already made, so, by definition, FM has to be created at the oscillator level. In other words, it can't be added at the final stage. In a modern rig, FM can be accomplished in various ways. Some radios induce the FM by wiggling the control voltage which drives the VCO. The rest of the frequency synthesizer loop is deliberately made too slow to compensate for such fast changes, so the VCO's frequency winds up wobbling along with the audio. *Presto*, FM. Another way is to phase-modulate the output of an oscillator with a tank circuit that includes a voltage-variable capacitor, or varicap. Although not true FM, phase modulation can be made indistinguishable from FM by using an audio filter in the mike amp. Most HTs use this method.

Yet another full-carrier mode, FM does not demand a linear amplifier. Class C will do fine, because the amplitude of the RF waveform doesn't change at all. In FM, only the carrier's frequency wobbles around as it tracks the modulation, so amplitude linearity is pointless. All of our VHF and UHF FM-only mobiles and HTs use class C amplifier stages. Especially at those frequencies, linearity is expensive and inefficient.

Why?

I keep saying that class C amplifiers are more efficient than linear ones, but I haven't said why. The reason has to do with how amplifiers work: They take DC power and modulate it with the incoming signal, like a gate. In a non-linear amplifier, the bottom of the incoming waveform is allowed to cause the amp to turn fully off, and the top lets it turn fully on. The amp spends practically no time in the in-between state. In other words, it acts like a switch.

A linear amplifier, however, spends lots of time partially on as it tracks the input signal. Thus, the amplifying element (transistor, IC or tube) acts like a variable resistor. We all know how resistors restrict current flow—they turn excess power into worthless heat. So, linear amps get much hotter, wasting lots of power. There are designs which reduce that problem, such as class AB, or "push-pull" amps. No matter what you do, though, the efficiency can never approach that of a class C amplifier.

Well, there's more to discuss, but I've run out of room. Until next time, 73 de KB1UM.

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Photo B. Dan KA2NZV loves to share ham radio with children.

Riding the airwaves at camp

One of the fun things about the hobby of amateur radio is that you can never run out of new experiences to have. For the past 18 years I've been teaching "Introduction to Amateur Radio" to 6th, 7th, and 8th graders at Intermediate School 72 on Staten Island in New York. I've always looked forward to having the summer off so that I can "recharge my batteries" and be fresh and enthusiastic for the fall term.

For the past three years, a camp director from a local day camp on Staten Island has been asking me to establish a ham radio program during the summer. An unusual confluence of circumstances this year prompted me to accept the offer. Little did I know what I would be in for.

It's been many years since I've been involved with a summer camp. I had forgotten how unlike school it all is. First was the problem of the location of the station. An old house trailer was completely refurbished for me. Walls were constructed, fresh paint was applied, shelves and a desk were built, new carpeting was installed, and we were ready for the equipment.

Nothing really worthwhile ever happens in ham radio with just one person. It's the nature of who we are and what we do that we interact and help each other. My good friend Marty WA2YYX played a key role in helping to get the station operational.

First, Marty thought that I should have a really distinctive antenna. So he constructed a resonant dipole antenna for all bands out of bright pink wire. I must say it really does stand out in front of the green trees. The kids always look up at it and chuckle as they enter the ham shack. The next purchase was for a Kenwood TS570D HF transceiver and matching power supply and an ICOM IC-W32A 2 m/440 MHz dual-bander. We used an MFJ Morse Tutor along with some Media Mentors code practice oscillators and code audiocassettes. We were all set.

To my surprise I was programmed to receive nine different groups of children every day. The ages of the groups ranged from four years old to 15. Because of the large numbers of children who wanted to come to radio, I got to see each of the 45 groups only once a week. This meant that lots of young people got their first exposure to ham radio this summer. Unfortunately, it was all fun, with very little instructional time—but several of the campers saw me privately about getting more information. I gave them EAD applications from the ARRL, along with my phone number so we could arrange for them to visit a local ham radio club meeting with me this fall.

Photo A. Steve KA2HXU (left) and Marty WA2YYX often stopped by to talk with the campers.

One of the best parts of the summer camp experience was when the ham we were speaking with stopped by to visit the children and give out their QSL cards in person. Marty WA2YYX and Steve KA2HXU were there many times, helping to set the station up and to meet with the children (**Photo A**). Dan KA2NZV made himself available to speak with hundreds of youngsters and to meet with them in person as well. Dan is a New York City detective who is dedicated to showing young people the benefits of our hobby (**Photo B**). My dear friend Brother Joe AC1U from Morrearo, Louisiana, was another ham who was on the radio every afternoon to welcome the children to the airwaves. Jim N2EIY donated a YAESU antenna tuner to us and spoke to many of the campers.

There were so many hams who made me proud to be an amateur radio operator because of the warm welcome they extended to the youngsters. I was especially touched when I was able to put some "challenged" young people on the air. It wasn't always easy to understand what they were saying; but so what? They loved coming to ham radio class because they could be good at something and there were always receptive, nice people for them to talk with on the radio. I commend all those hams who knew what I meant when I introduced these "special" groups.

I'm so used to teaching ham radio in the structured format of a school setting all year, that it was really an interesting challenge for me to tackle the camp situation (**Photo C**). Each youngster was provided with a little lap desk and paper and pens. I had a chalkboard along with my radio world maps and globes. The camp experience added another dimension to my ham radio experience. We even had a special JCC Day Camp QSL card made up.

If anyone out there decides to give radio a chance in a camp setup next summer, be sure to contact me. There's no point in reinventing the wheel. I learned a lot this summer, which is usually the case when a teacher really gets

Photo C. All the children loved spending time in the JCC ham shack this past summer.

Number 76 on your Feedback card

Homing In

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
[Homingin@aol.com]
[http://members.aol.com/homingin/]

Surprise!

Ham radio is full of surprises. Catching a rare DX station as you cruise the bands in the wee hours, suddenly hearing Hawaii on your two-meter handheld when transoceanic ducting comes in, discovering an old friend rag-chewing on 10 meters and reliving old times—these surprises make our hobby a joy.

If you like surprises, you'll love hidden transmitter hunting, also called foxhunting or T-hunting. Every time you set out on one of these radio direction finding (RDF) contests, you never know where you will end up, and you usually have no idea what you'll find there.

Surprise endings are common on T-hunts. They are both entertaining and educational. Southern California hiders have many ways to surprise hunters. They bounce signals from mountain peaks and find unmapped roads in the wilderness. Sometimes they camouflage their transmitters inside common objects, then put them in plain sight.

The best T-hunt surprises involve deception. Not out-and-out lying, of course, though some T-hunters aren't above prevarication while the hunt is in progress. By deception, I mean the same concealment of strategy that takes place on a football field or in a poker game.

You just never know

Marvin Johnston KE6HTS of Santa Barbara likes hunts that include some on-foot transmitter tracking. "Most of the time, my team hides a number of Ts at a local park with notes attached," he writes (**Photo A**). "On one hunt, special rules gave any beginners a 10-minute head start. One new ham showed up at the starting point and received the early go-ahead, although nobody thought it would help him.

"Out at the park were three transmitters," KE6HTS continues. "Most people found the first with no problem. The second didn't prove to be too difficult, but almost everyone had trouble finding that last one.

"Our beginner found his way to the park and soon he had a slip for one T. Everyone noticed that the third T seemed to be changing directions. Our beginner got tired and sat down to rest for a bit. One of the other hunters got a strong signal near him and asked if he was sitting on the T. He jumped up and started searching again, but no luck.

"One hunter had a field strength meter and our beginner got a chance to see how effective it was in getting bearings. He commented that the signal was really pretty strong so it must be nearby. After another five or 10 minutes passed, everyone finally figured out that our beginner was a ruse. He was *wearing* the hidden T!"

It's horizontal, and it's upstairs!

When T-hunting first surged to popularity as a club activity more than four decades ago, a hidden transmitter had to be inside a rather large object to be truly hidden. The tube-laden rigs of that era generated lots of heat and needed lots of battery power. Today a hidden transmitter can go almost anywhere, as was proven by Steve Harris KD6LAJ on a Sunday afternoon hunt in the San Gabriel Valley of southern California. Steve built a tiny two-milliwatt device to fit inside a bikini top.

"It is just a little oscillator that I originally designed to run on nine volts," Steve says. "The batteries are on one side and the oscillator on the other. I ran fine wires in the string strap from cup to cup for power, and around the back for the antenna. This gives the signal horizontal polarization. The negative power lead serves as the counterpoise."

"The nine-volt battery was too big and uncomfortable so I redesigned it to use two AAA cells," Steve continues. "The battery holder is carved out of practically nothing. It and the oscillator are embedded in some 3/16-inch foam and there is another layer of thin foam on the outside, so the circuitry can't be seen."

KD6LAJ asked Tonya Beverly, a friend of one of his friends, to wear the bikini-T so that none of the hunters would recognize her. Tonya turned out to be quite an actress. "I had her sit on a blanket in a park with her book, just studying and sunbathing," he recalls. "Actually, she did have a final exam the next day. I figured hunters might be reluctant to go up and talk to her, so I encouraged her to speak to them."

The Tonya-T was actually the second transmitter in that day's event. The first was transmitting continuously on another frequency to get the hunters and their vehicles from the starting point to the park, which is on a dead end street in the city of Glendora.

"The first hunter to the park was Rick Barrett KE6DKS," says KD6LAJ. "He found the first transmitter with its sign-in sheet, announcing the second transmitter frequency. As he began to get bearings on it, Tonya walked over to him and asked what he was doing, pranced around him and confused him really well. After all, it's hard to get bearings when the T is moving around you!

"She then walked back to her blanket. Being a gentleman, Rick

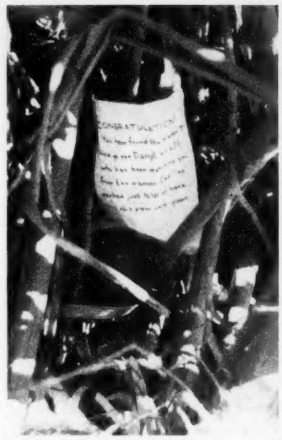

Photo A. *If you don't want hiders to get carried away and dig up your buried or well-camouflaged transmitter, attach a note with instructions so that they find (and read) your note first.*

walked over to me and asked, 'I have only one question, how come the T follows her around?' I decided that was good enough and told him what was going on.

"The next hunters were Milt Ronney WA6FAT and his son Martin WB6YMI. When she went over to them, they were totally distracted. Martin got to talking with her so much that I don't think he ever figured it out. Then Don Lewis KF6GQ and Scot Barth KA6UDZ came into the park. I had told Don to expect a unique hunt, so he brought his video camera. Scot found the high-power transmitter first and soon had a pretty good idea where the second one was.

"Don started a bit later because he was taking video, but eventually his equipment led him to believe that Tonya was sitting on the RF source. He told her to get up, then he grabbed her papers and blanket and threw them in the air (**Photo B**). Not finding the transmitter, he asked if it was in her shorts. 'Look,' she told him indignantly, 'there's no T in my pants!' Scot immediately replied, 'Check the signal again. It's horizontal, and it's upstairs!'"

Flyaway fox

One of the most elaborate deceptions I've heard in a long time was by Greg Miller KJ7GJ

---

into something. For the pure pleasure of sharing a great hobby with children in the relaxed, carefree atmosphere of a camp, you can't beat ham radio as an activity. It also offered a good alternative to those kids who were not especially athletically inclined.

For those of us who are dedicated to working with young people and helping them to become the best they can be, I suggest you get involved with a school or a camp, and help to introduce them to the wonderful world of amateur radio. 73

of the Boeing Employees Amateur Radio Operators North Society (BEARONS) in June of this year. This club has a set of basic hunt rules, but allows the hider to set specific conditions for his or her hunt.

Greg announced an eight-page area in the bound Seattle area map book as the boundaries for the hunt. He chose a meeting point for the hunters at a restaurant just outside the boundaries. He told them that if they didn't all hear him at the start to coordinate with one another to get an initial bearing.

Greg advised that this would be a "semi-mobile" hunt. The fox would be stationary for the first 30 minutes, then move to another spot while still transmitting regularly. It would stay at the second spot for 30 minutes, then move again, and so on, for a total of three moves. Each move would take no more than twenty minutes.

To win this hunt, a team had to be first to find the fox vehicle. Greg promised to respond if they waved, flashed lights or honked the horn at him. "What these intrepid souls didn't know," says Greg, "was that I was going to be airborne with my friend in his Cessna Cardinal. The stopping points were to be local airports on the selected map pages.

"I had called Charles Scharlau NZØI, the local hunt organizer, to talk about the rules I would use," Greg continues. "I always used the word 'vehicle.' Charles didn't even notice it and assumed I was talking about my little red Sundance.

"At the start, we were on the ground at Paine Field, five miles north of the starting point. I could hear some people over around 128th Street in Everett talking about picking up the signal. We remained there at Regal Air for a half hour. The hunters were closing in, but we got airborne before anyone could see us.

"Without telling that we were moving, we headed east about half way across the hunt boundary with the intent of going to Monroe. The weather minimums were below standard for landing there, so we turned north, then turned around and circled my house to give them something semi-stationary. We went around about seven times and then lined up at Monroe again. There was still a heavy crosswind and rain. We started the descent, but the pilot quickly decided it would be best to execute a missed approach and go to Harvey Field to land. That airport is at Snohomish, about nine miles northeast of the starting point.

"We had no sooner touched down at Snohomish and were rolling the plane under cover when Jim Bowman W7HPK and his wife Betty drove in. About the time we were getting into the pattern at Harvey, they had been coming across the valley and headed to Monroe. We came in across that road and they saw the signal strength come up. We entered the pattern, which caused signal to go up again. They were driving off the end of the field when we landed and the signal went up and down for the third time.

"They checked all the parking lots in the area, including a restaurant and baseball diamond. Just as we were finishing pushing in the plane, they saw me. Shortly thereafter, Charles and his wife Karen N7SRO showed up. Charles identified the transmitter, which was sitting on the tail of the airplane. Then he remained transfixed, staring at the airplane in a mixture of consternation and disbelief.

"Rich Wilson N7WWU and Tom Bruhns K7ITM showed up and, after spotting some familiar cars in the parking lot, parked and hunted with their sniffing gear for quite a while. I repeatedly told them that the transmitter was in 'plane sight.' Finally Rich walked out among the hangars and found the transmitter.

"Most of the hunters' initial inclinations were to do me bodily harm, but they all showed admirable restraint. We gathered at a restaurant and discussed the hunt over lunch. Interestingly enough, Jim and Betty were able to tell almost exactly where we had flown, having gotten accurate bearings all along. The only reason that they didn't catch me is that they weren't looking up. Strangely, no one seemed to want me to be the fox again any time soon."

Doppler-to-APRS update

Back in August 1995, "Homing In" described a simple interface unit that ties Doppler RDF sets into the Automatic Packet Reporting System (APRS) program by converting the Doppler's LED direction indications to a RS232 data stream. Robert Swain KA4JSR, then N7LUE, developed the interface and sold kits for it. Judging by my mail, the project is still popular, but Robert has stopped selling kits due to lack of available time.

Fortunately, KA4JSR has put his circuit into the public domain. A supplier of bare boards has been found, so you can still build the project at home. All of the details are at the "Homing In" site on the World Wide Web. The URL is at the beginning of this article. At least one of the ICs has become scarce, so check the latest project status at the "Homing In" site before ordering.

The Swain interface works with almost every LED-readout Doppler set in the amateur radio market, including all versions of the Roanoke Doppler. However, it is not intended for use with the Agrelo DFjr™, which has its own proprietary RS232 and APRS interface provisions. 73

Photo B. *"OK, I'll get up!" Scot Barth KA6UDZ (left) and Don Lewis KF6GQ (right) think Tonya is sitting on the hidden transmitter (photo by Steve Harris KD6LAJ).*

Number 77 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

Field Day without OSCAR 13 or Phase 3D

When the orbit of AMSAT-OSCAR-13 finally decayed late last year, many had hoped that Phase 3D would soon be launched to take its place. P3D was scheduled for a ride to space on the second flight of an *Ariane 5* rocket from French Guiana. The first flight of an *Ariane 5* ended in disaster on June 4, 1996.

The *Ariane 501* rocket performed perfectly, but the software failed in the inertial guidance system. The *Ariane 5* has two guidance system computers and both had malfunctioned. Code for an *Ariane 4* rocket had been inadvertently loaded into the system. Differences between the two rockets are significant.

Soon after liftoff the guidance system had been commanded to turn too quickly. The rocket veered out of control and self-destructed only 30 seconds after ignition. Not much was learned about the flight

Continued

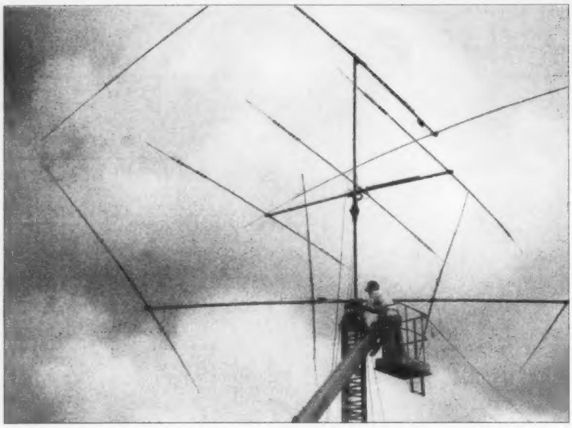

***Photo A.** Serious HF antennas at the K5DX Field Day station needed some minor repairs as the competition began.*

characteristics of the first *Ariane 5* in those 30 seconds, but some data concerning vibration and other launch stresses was gleaned from the telemetry.

When AMSAT (Radio Amateur Satellite Corporation) was notified by ESA, the European Space Agency, that P3D would be subject to stresses on the *Ariane 502* flight beyond the current design parameters, a study was initiated to identify any deficiencies in the satellite and correct them before launch. These efforts have been a focal point of work on the satellite and have caused delays with other key components in P3D construction.

AMSAT technicians, engineers and volunteers worked diligently during August to finish structural enhancements to the spacecraft. Teams from Germany, Belgium, Slovenia, Hungary, Japan and the Czech Republic descended on Orlando (Florida) to join the effort to ready the P3D transmitters, receivers, momentum wheels and computer modules. If there are no further slips in the ESA schedule to launch *Ariane 502*, and the round-the-clock efforts to finish the mechanical upgrades and component integration are not completed in time, P3D may have to schedule a different ride to orbit.

During its lifetime, A-O-13 was available for eight Field Days from 1989 through 1996. With beam antennas and 25 to 100 watts on 70 cm, many excellent contacts were possible for any Field Day group that wanted them. A few years had marginal orbits over the US during the fourth weekend of June, but some access was always possible during the 24-hour contest period.

***Photo B.** The K5DX satellite Field Day operators enjoyed the luxury of a new motorhome for the 1997 event. Air conditioning, TV and microwave ovens certainly help.*

P3D promises the same quality contacts, but with some significant improvements. The key differences between A-O-13 and P3D are the number of transponders and the ground station requirements.

During its last years, A-O-13 supported two transponder modes, B and S. Both had 70 cm uplinks, but Mode B had a two-meter downlink while Mode S had its output in the 13 cm band. P3D sports a matrix of uplink and downlink possibilities ranging from a receiver on 21 MHz to a transmitter on 24 GHz. The individual receivers and transmitters can be paired up by ground control stations in any possible combination as long as a frequency conflict does not occur.

Due to the height of the apogee or high point of A-O-13's orbit, signals from the satellite's transmitter were relatively weak on Earth compared to other hamsats. While the low-orbit satellites are usually only 600 to 1000 miles up, A-O-13 ranged out beyond 20,000 miles. P3D will use a mix of gain antennas and power amplifiers to overcome the distance factor from a similar orbit. P3D ground stations will require smaller antennas for the same results they had through A-O-13. On Field Days of the future, it may be possible to use simple omnidirectional antennas and still make solid contacts. Small dish antennas should be acceptable for the microwave bands. The digital transponders on P3D will add other possibilities not yet considered.

For Field Day 1997, though, neither A-O-13 or its replacement, P3D, were on hand to carry the contest. Enthusiasts were forced to check the other hamsats. The results were surprising.

A-O-10 vs. Fuji

During Field Day many expected AMSAT-OSCAR-10 to carry a large percentage of voice and CW activity even though it has been virtually uncontrollable since 1986. When the solar panels are sufficiently illuminated, A-O-10 can provide excellent communications.

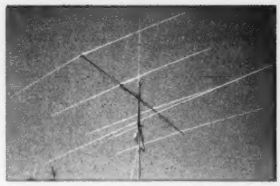

***Photo C.** K5DX had two satellite arrays. This one had an omni antenna for two meters, a four-element yagi for 10 meters and a dipole for 15 meters.*

During the contest, A-O-10 was working quite well but signals from the satellite, when at apogee, were weak for most portable stations. Field Day participants were forced to find other transponders for their efforts. The low-Earth-orbit (LEO) satellites took over. Fuji-OSCAR-20 logged the highest percentage of Field Day contacts with RS-15 and Fuji-OSCAR-29 running just behind A-O-10. The relatively high orbit of F-O-20 allows longer access times and greater distances than most LEO hamsats. RS-15 also has a high orbit for a LEO, but the relatively weak downlink on 10 meters encourages the use of beam antennas and RF-quiet locations. RS-12 and AMRAD-OSCAR-27 provided additional opportunities for satellite contacts although the single-channel FM transponder on A-O-27 sounded more like a giant pileup on an FM repeater. On the analog side, Field Day via satellite was a lot of fun.

For those who were equipped for digital operation, the 9600-baud satellites provided many points in the AMSAT Field Day competition. The American Radio Relay League Field Day does not recognize uploads and downloads via the digisats, but AMSAT does. Each Field Day greeting upload addressed to ALL (one per satellite) and all the Field Day greeting downloads sent by other stations count for three points each. Although it is possible to get a respectable score just by working the analog satellites, to get first place in the AMSAT activity requires a presence on the digital systems. Due to the nature of the AMSAT rules, it is even possible to get points without transmitting. Many short messages (like Field

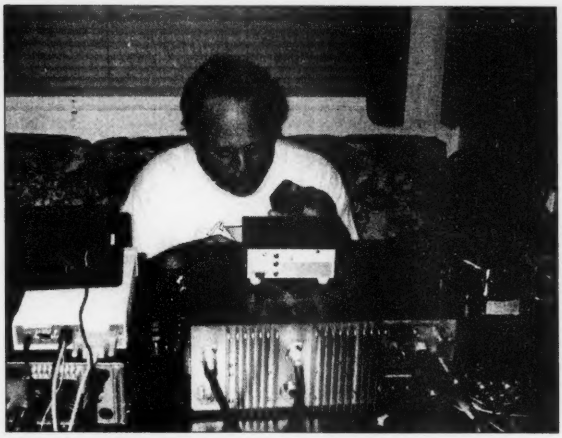

***Photo D.** Mike WA5TWT works a Fuji-OSCAR-20 pass at the K5DX Field Day satellite station.*

Day greeting messages) can be received from the digital satellites simply by monitoring the downlink and collecting all the traffic that the satellite transmits. Although no SWLs (short wave listeners) submitted entries this year, it is certainly a possibility in the future.

Kitsat-OSCAR-23 logged the most messages due to its high orbit and excellent signal, while Kitsat-OSCAR-25 and UoSAT-OSCAR-22 certainly added to the totals. Some stations also used the 1200-baud systems on AMSAT-OSCAR-16 and Lusat-OSCAR-19. The 9600-baud hamsats were clearly the front runners, but the others provided extra points.

John Stephensen KD6OZH had the highest verified score in the AMSAT contest from his home in Los Angeles, California, using emergency power. John operated through A-O-10, F-O-20, F-O-29, RS-15, A-O-16, L-O-19, U-O-22, K-O-23 and K-O-25. The Sussex County Amateur Radio Club came in a close second with verified contacts and digital activity from their portable location in New Jersey using the callsign N2WM. They skipped the 1200-baud satellites, but added analog operation through RS-12 and A-O-27. Many others participated in the competition, including DX stations in Europe, Africa and Central America. As can be seen by the list of hamsats available for the event, there are many exceptional communications resources available even without A-O-13. 73

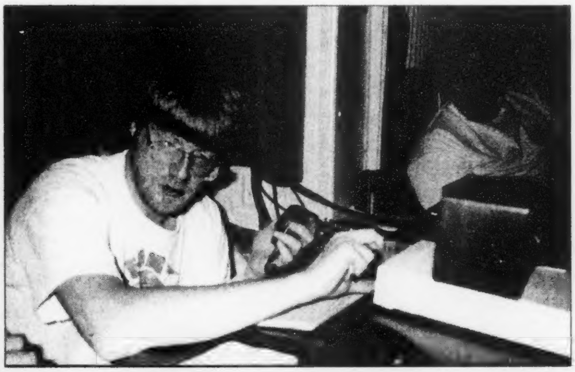

***Photo E.** Marty WD5DZC checks out an early morning AMSAT-OSCAR-10 pass while Charlie N5XGW listens at the K5DX Field Day 1997 satellite station.*

NEVER SAY DIE

Continued from page 70

Rock'n'roll, rap, and so on produce stunted plants. Classical music spurs growth. Just as with kids.

Water, in some way, is able to store magnetic energy too. If you want really powerful water, first distill it so you're rid of the fluorides and chlorine in our tap water, then put the water in a glass bottle in the sun with the south pole of a strong magnet under the bottle. If you can find some quartz glass bottles, they'll do even better. Use this water for your plants, and for your own drinking too. Remember, your body needs about eight glasses of water a day to function best.

The north pole has its uses too. For instance, animal research on cancers showed that a magnet could stop the growth of cancer. This research was done over 20 years ago, but as far as I've been able to find there isn't any hint that the National Cancer Institute has made any effort at all to follow up on this work. Well, the treatment isn't patentable, so there's no commercial interest in developing it. A low-cost cancer cure would lose the medical industry hundreds of billions of dollars in revenues and put thousands of cancer researchers out of work.

If you think I'm crazy on this, then at least do me the courtesy of doing your homework. I've done mine. And then get some strong magnets and see for yourself what north and south poles can do for your plants, for you, and your children.

The Rawles and Davis book also lists a bunch of illnesses that can be helped with magnets, using the north pole to slow or stop unwanted functions and the south pole to improve circulation and energize organs. Which may explain why my visiting friend is convinced that magnets can help or cure almost any illness. Now, if I can just get him to start writing some articles on the subject!

Forgetting Things?

Talk about getting too late smart! Several years ago I heard Dr. Hal Huggins (a dentist) giving

Continued on page 83

Number 80 on your Feedback card

New Products

Join the Fun on the Magic Band!

MFJ's new MFJ-9606 *FM Communicator*™ is a perfect 6 m transceiver for No-Code Techs and veterans alike—use it for packet, data or voice. Packet-ready and compatible with virtually any TNC, the MFJ-9606 is the perfect way to stay in touch with your club members, especially with the growing number of 6 m repeaters.

The 10-watt transmitter has plenty of power to enjoy FM simplex, repeater or packet service, and if you need more power out, it's fully compatible with MIRAGE's high-power 150 W A-1015-G amplifier.

MFJ-9606 features MFJ's exclusive *CrystalClearVoice*™ that gives true-to-life speech quality and ultra-clean AFSK data signals. An optional plug-in CTCSS encoding module is available soon for accessing protected repeaters. Superfast PIN diode transmit/receive switching keeps turnaround time real low—perfect for packet and other data modes.

The MFJ-9606 can be run 24 hours a day without even getting warm, drawing less than 30 mA. It gives you a super dual-conversion FM receiver with quiet LNA front end, the same LNA used in the popular 6 meter SSB MFJ-9406 transceiver—exceptionally pleasant because of its clear audio reproduction, loud built-in speaker, and choice of squelch modes.

Choose your squelch! Select conventional hysteresis squelch for weak signal base-to-mobile service, use MFJ's exclusive *Instant-OnSquelch*™ for tail-free repeater or packet operation, or use open squelch if your TNC has a noise rejecting DCD.

Built to last and designed for simple operation, the MFJ-9606 is only $149.95, and of course it's covered by MFJ's famous *No Matter What*™ one-year unconditional warranty. For your nearest dealer or to order, call (800) 647-1800; FAX (601) 323-6551; or write to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.

Wefax for Windows™

SSC is proud to announce the release of PC HF Facsimile 8.0 for Windows. PC HF Facsimile 8.0 allows users of Windows PCs to receive wefax charts, weather satellite photographs, radio teletype, NAVTEX, FEC, SITOR, ASCII and Morse code digital news and weather broadcasts. By connecting the package's demodulator between the computer's serial port and a single sideband shortwave communications receiver, digital radio transmissions can be received, displayed, printed or recorded on disk. SSC's new Windows FSK demodulator allows the program to operate in the background while the operator is performing other tasks under Windows. The package is ideal for mariners, aviators, agriculture and weather enthusiasts.

It includes image and text decoding software, a miniature demodulator, tutorial audio cassette, comprehensive manual, worldwide frequency list and broadcast schedules. System requirements are Windows 3.1x, Windows 95™ or Windows NT, 8 Mb ram memory (4 Mb under Windows 3.1x), 6 Mb hard disk space—and all for a suggested retail price of $179.95.

Collins Fans Take Note!

Hi-Res Communications has introduced three new video additions to the famous Collins Video Library! "The R-390A" features noted expert Chuck Rippel WA4HHG, and runs a full seven hours, covering topics like "Modules," "PTOs," and "Restoration." It's an amazing education in the R-390A, for only $109.95.

"The 75A-4" features Butch Schartau KØBX, who will guide you through four hours of information on how to repair, maintain and restore this classic, for $89.95.

For owners of the "Gold Dust Twins," "The KWS-1" is the perfect companion to the 75A-4 video. Butch Schartau shows you how to operate, maintain and repair your KWS-1. This two-hour video is a must for all KWS-1 owners, at $39.95.

Purchase of any three or more videos from the Collins Video Library qualifies you for a 10% package discount, and VISA and Mastercard are gladly accepted. For mail orders, add $4.50 each for the first two videos for shipping in the US. Additional videos are shipped at no extra charge. For more information, contact Hi-Res Communications, 8232 Woodview Drive, Clarkston MI 48348-4058. Phone or FAX (248) 391-6660; E-mail: [hires@rust.net]. Check out the Web site at [http://www.rust.net/~hires].

Mouser Unveils New Web Site

Mouser Electronics, one of the 50 largest electronic component distributors in the US, recently updated their Web site. New features include a user-friendly interface, product pricing, product availability, and excellent search engines, allowing searches by part number, manufacturer's name, product type, keyword, or catalog page. There are also links to Mouser's manufacturers' Web sites. Catalog pages are viewable with Adobe Acrobat Reader 3.0™, which can be downloaded from their Web site.

The complete Mouser catalog can also be downloaded—it takes a while but it's worth it; it's well done and text searchable. On the Web site you'll find a subscription form for the CD catalog, and both the downloadable catalog and the CD-ROM catalog are PC and Mac compatible. The paper version of the catalog can be ordered on-line, too. Check it all out at [http//:www.mouser.com].

Every CyberHam Needs One

Does your mousepad have your callsign on it? No? Like, you're *so* ten minutes ago! Ask your teenager what that means—and then get the latest catalog from Old West Graphics. They have a whole line of graphic mousepads, in categories such as Cowboys, Skywarn, Trucks, etc. When hams order personal mousepads, they choose from the available designs and Old West Graphics will add callsign and city/state to the design—for only $16.95 plus $1.50 s&h. Club event coming up? Old West Graphics also manufactures banners, ARC logo decals, magnetic signs, and other stuff so you can let the world know about your hobby!

Write to the nice folks at 490 N. St. Louis Ave., Loveland CO 80537-5878 or call (800) 484-9492 ext. 8601. To FAX, press 0 at the prompt.

Number 81 on your Feedback card

Communications Simplified, Part 23

The series concludes.

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

As I mentioned when I started this series almost two years ago, these "Communications Simplified" articles are a sort of work-in-progress—they are class notes for a community college communications course. They will eventually become a textbook; in the meantime, I thought hams and readers of *73 Magazine* might be interested in them, too.

But that college course has changed in the past two years. All of my current communications students are telephone company employees, and so I've had to go off in somewhat different directions. You may have noticed that as we discussed modems and ISDN lines last month. From this point on, my course will become even more telephone company-specific.

Unfortunately, this is going to bring us further and further away from ham radio, so I've decided to end this *73 Magazine* series before I bore all you readers to death.

Let me, therefore, end with an absolutely true story. I vouch for the fact that it really happened about ten years ago.

One of the older lab experiments in our course has been to give our students a defective AM radio, and ask them to troubleshoot and repair it. These troubles are usually fairly simple, but it still takes most students an hour or two to find the problem.

This one term, though, one of the groups called me over within five or 10 minutes: "Professor Stark, Professor Stark, come here, come here, we fixed it!"

I went over to see.

Their radio was still connected to a bunch of test equipment, and all I heard out of the speaker was a loud beeping tone.

This particular group consisted of some of the weaker students in the class, so I was sure they couldn't possibly have found the problem so quickly. I was convinced the tone was caused by the signal generator that was still connected to the radio, so I started looking for something to prove them wrong.

I was just about to make some snide comment, when the tone stopped and the radio said "This was a test. If this had been a real emergency ... "

P.S. I was right. Their radio had a bad oscillator, but they had accidentally connected their lab signal generator to a point where it would provide a substitute signal. Then they noticed that, as they tuned the signal generator, they heard some stations. So they just tuned in a local news station, and called me over.

Well, I hope you had as much fun learning from this series as I had presenting it.

Here's to simplicity!

Remembering Ivan's "Woodpecker"

Or was it?

A.N. Onymous

I had a dream last night about the woodpeckers of yesteryear, and I awoke very troubled—as one does in the aftermath of a nightmare ...

It was a beautiful Sunday morning back in the early '70s and I was chatting with an old friend on the low end of 40. A woodpecker ended it all. Pinned the S-meter 40 over nine, and wiped us out. Finally, the pecker quit. We were both upset and signed clear.

I leaned back in my chair to consider this plague on shortwave radio. Finally, reason prevailed and I said to myself, "No damned over-the-horizon radar station in Russia could possibly be that strong here in Oregon on 40 meters at 11:00 in the morning because the skip is wrong. Even Rollie, a few blocks up the street, wasn't much stronger and he was line of sight ... Line of sight? Up? Satellite? Possible!"

A few minutes later, I had my old surplus scope going, and was looking at the audio output from my old National to see what this plague was. Shortly, I had some answers. First off, it wasn't just one pecker—there could be several of them individually controlled, or group controlled. That was why the tone of the pulse seemed to shift at times. They all worked exactly at the same repetition rate, but with different start times. Further, when I set the scope delay and looked at the top of the pulse with the delayed, expanded sweep of my old scope, I was startled to see video riding on top of the pecker. As a TV ex-chief engineer, I very well knew what a single line of video looked like.

I was an assistant professor at a local community college, so I gathered myself up and spent the rest of my Sunday in the lab unscrambling peckers. At that time we had quite a bit of good surplus equipment, including several 535s, an excellent Tek timebase, and a good, magnetically-deflected 14-inch monitor with P7 phosphor.

We had an old all-band receiver with only one stage of 456 IF which was fairly broad. Not the best, but OK for a pecker picker-upper. It didn't take long to figure out that a horizontal line for the monitor would be the pecker pulsewidth, and the vertical scanning was formed by the motion of the satellite as it traveled at about 17,500 mph over the area being observed. The satellite pulse rep rate was extremely accurate at 10 pulses per second. In order to get a reasonably stable raster on the monitor from a pecker, I had to use our Tek timebase, which had a temperature-controlled crystal oscillator and divide-down multivibrators.

I used two old Tek 535 scopes for the horizontal system. The first scope was synced to the Tek timebase. Its CRT was used to select a pecker from the group for observation and to provide a delayed trigger to enable the second scope, which showed a line of video per pulse. The second scope had output terminals for the truncated sawtooth it used to sweep the CRT. This became the horizontal sweep for the monitor. The vertical scan came from a third Tek scope running free, quite slowly, with its external sawtooth fed to the monitor and set to make a symmetrical presentation on the P7 screen.

Most of the pictures we looked at were clouds, but we had enough detail to see pattern breaks—occasionally. We didn't try to correlate our monitor screen with a known landform, as it wasn't our purpose. But it was quite evident what the pecker represented. On the following Monday, I showed the setup to some fellow instructors who were ham friends and explained it to some advanced students. Then I dismantled it and put the components away. I had answered all the questions but one.

That summer was hamfest time in our area, and of course I attended. Things started to slow down. I went to the person in charge of program presentations and said I could explain what the Russian Woodpeckers were and he said 4 p.m. in the meeting hall. Believe me when I say the place was crowded, and they weren't all happy campers. I went to the blackboard and diagrammed what the pecker was, and the interconnection of surplus gear I had used to unscramble it. I concluded my presentation by saying that we didn't really know who was responsible for the peckers, but that it was strange that the pecker activity really picked up at the start of the war between Afghanistan and Russia.

And why would Russia use satellites when they could use airplanes? Then I added that if indeed the peckers were ours, they were looking after the best interests of all of us.

The next February there was a hamfest near Salem, and I was asked to come and repeat my lecture on the Russian Woodpeckers.

I agreed to do so. When the time came, I was introduced to the crowd as the guy who figured out what the woodpecker was, and that CBS television had confirmed my findings by recently carrying a story on the late news that the United States had admitted our forces were responsible for the "Russian" woodpecker. Nothing further was ever said and soon they shut them down. A year later, the head of the FCC was still calling it the Russian Woodpecker and describing it as a Russian over-the-horizon radar. A bad rap.

Well, 25 years later there's the story, and the question is, *Who really told a story?* As for me, "Ain't nobody here but us chickens"—but I do think old Ivan could use an apology.

NEVER SAY DIE
Continued from page 79

a talk on mercury poisoning at the Tesla Society conference in Colorado Springs. Quite a few hams attend this conference every year and they even have a ham station set up in the conference lobby. Anyway, that was the first I'd heard about the mercury in dental fillings being dangerous. Hal made a very convincing presentation, complete with some videos showing the amazing recovery from multiple sclerosis of people who'd had their amalgam fillings replaced with plastic. This was of particular interest to me because one of my grandmothers died of MS, and there's always the nagging thought that it might somehow be a genetic illness.

Hal's book, *It's All in Your Head*, was very well documented and, I thought, a book everyone really ought to read, so I included it in my guide to key books.

Cut to May this year when I was on the Art Bell (W6OBB) radio talk show. In addition to our talking about amateur radio for about an hour, I mentioned that I was convinced that all illnesses had to do with either our poisoning our bodies, or giving them too little of the nutrition they have been designed to operate on. I included dental amalgam in my list of poisons and Art got all upset. His dentist, in whom he had great confidence, had assured him that amalgam fillings were perfectly safe. Art refused to accept my information.

Then, when he opened the phone lines, two dentists called in and both said I was absolutely correct, that the mercury in fillings is a deadly poison. Art was depressed over this news because he has several fillings, as most people have.

Lydia Bronte heard about this and sent me a copy of her book, *The Mercury in Your Mouth — The Truth About "Silver" Dental Fillings*. This is published by Quicksilver Press, 10 E. 87th St., NYC 10128. 1994, 189p, $15, ISBN 0-9643870-0-X. You really ought to invest in this wonderfully researched book. You won't believe the long list of illnesses which have been cured or greatly improved by removing amalgam fillings. The chapter on mercury's connection to Alzheimer's made me wish I'd done my homework in time to help save my mother from this terrible disease.

This is not a matter of opinion, for endless research has been done on both animals and humans and the fact is that the mercury in your fillings (they're about 50% mercury) leaks out into your body where, depending on your sensitivity to it and other immune system depressants, you can be heading for an Alzheimer's future, Parkinson's, antibiotic resistance, and any number of autoimmune problems.

Judging from the incredible number of hams I see at Dayton who have great big fat guts and are smoking, I realize that my preaching about health is probably, at the least, irritating. If you wanted to live much past your 40s in good health you'd have changed your living style long ago. Most people (and that, generally, includes hams) live for the pleasure of the moment and don't even want to know about the long term results of what they're doing. Otherwise they wouldn't be eating the garbage they are and dumping one poison after another into their bodies.

I've taken better care of my body than most people, so at 75 it's in pretty good shape. Oh, I've dumped a ton of doughnuts and coffee into it at ham club meetings. And tons of ice cream and soft-serve, plus more tons of pies, cakes, and cookies. Heck, I was about 100 pounds overweight until 25 years ago, when I decided to stop that nonsense. Been there, done that.

Now that I know better I've been treating my body with more respect. It gets lots of fruit and vegetables, plenty of distilled water, daily exercise, and so on. No, I don't have any fillings. I had 'em all removed years ago. But up until then I had a mouth full of 'em, and several root canals too. More poison.

Yes, I know the ADA is still saying that amalgam fillings are safe. And the cigarette makers are swearing that cigarettes are not addictive and don't kill us. Just think of the lawsuits dentists would face if the word got out about the millions of people they've killed via mercury poisoning.

Getting your fillings replaced isn't easy. The Bronte book lists dentists who will do the job, but the ADA is busy making life miserable for these renegade dentists.

Health Tompoopery

Lordy, I need an assistant just to deal with the piles of Tompoopery my mail brings almost daily. There seems to be an endless supply of "scientifically proven" nostrums, many being peddled via multi-level distribution systems. If I'll sign up as a distributor I'll get a 50% commission on what my customers buy and 20% on what their customers buy. What a great chain-letter approach to selling!

Unfortunately, the more I read by authors who make sense to me, the more I'm convinced that our whole medical industry is no more reality-based than the nostrum peddlers. If you are convinced that ingesting hexichlorodimethylbenidrine is going to alleviate the symptoms your body has been flashing as a warning signal that you're screwing up, then pop those expensive pills.

Health is simple. Robust, vibrating health is simple.

Within the limits set by your genetic makeup, and that includes any damage done by your parents to your genetic blueprint even before conception, your body is designed to operate and renew itself for around a hundred or so years. You can screw this

marvelous system up by throwing sand in the gears, sugar in the gas tank and sludge in the sump—putting poisons in your body and not providing it with the fuel it's been designed over millions of years to use. News flash: your body was not designed to function on a coffee-and-Danish breakfast.

Does that make sense?

Look, even the worst of plagues had survivors. So, how were they different? Simple: They hadn't crippled their immune systems.

If you want to give your children their best chance at being healthy and intelligent, then don't do things that are known to cause birth defects—like smoking crack, drinking alcohol, smoking cigarettes, drinking coffee and so on. These all create birth defects, though many are not easily visible. And this means not just during pregnancy, but even before conception.

Your body is designed to deal with the nutrients at hand back in the prehistory days. Raw foods. Clean air. Sunlight. And a lot of exercise.

So we eat cooked food, usually laced with chemicals to keep it from spoiling on the grocery shelf (and in the distributor's warehouse), and we poison our bodies in a wide variety of ways, all of which reduce our immune systems' ability to deal with emergencies.

Poisons? Mercury from dental amalgam. Fluorides in your water supply. Chlorine, ditto. Nicotine, caffeine, alcohol, aspartame in diet drinks, immunization shots, air pollution, sunglasses to keep needed sun's rays from reaching your eyes, electromagnetic fields from electric blankets (and amplifier power supplies), radiation from TVs, and so on. You really don't want to know the horrible history of what the introduction of sugar and white flour has done to one civilization after another.

Oh, I almost forgot, our food supply is grown in fields which long ago lost their critically important (to our bodies) minerals. When they're added to the fields the results are truly amazing, but it's easier and cheaper to throw on chemical fertilizers (NPK), so that's what's happening all over the world.

Every bit of what I've said here is backed up by books reviewed in my guide to books you should read.

The bottom line is clear: when you get sick, you've done it to yourself. So you can look for a magic cure with any of the endless nostrums, or (even worse) medications from your friendly doctor. Well, that's better than changing your diet, right?

The Deficit

Old what's his name, the guy with the big ears down in Texas, made a great big deal out of the escalating deficit. I love all the creative accounting both the Republicans and the Democrats are using to make it seem as if the deficit is being reduced. A reduction in the growth of the deficit is being heralded as a reduction of the deficit.

P.J. O'Rourke, in his *Parliament of Whores* (his name for Congress), showed that the budget could be easily balanced, if Congress had the guts. Guts is not a requirement for being elected to office, just an extended hand, palm up, for money.

I love Congress' move for a balanced budget amendment. It's a please stop me from hurting our country deal. A sort of moral imperative for the totally gutless.

Well, enough of my fruitless grumbling—there's no way I'm ever going to convince you to stop re-electing professional politicians and flush that stinky Washington toilet. So let's contemplate the deficit.

A big part of the budget every year is the interest on the accrued deficit, which has been heading up towards equaling the country's annual revenues. And that doesn't even count the trillions of off-budget liabilities and expenses. Interest payable to whom? The government bond holders, which are mainly foreigners and the banks that make up the Fed.

So these banks lend our government the money for Congress to spend. And where do they get the money to lend our government? Well, they're "good for it." Cozy arrangement, and one that's been going on for a long time. It's probably better that I don't write much about all this, else I could find myself disappeared.

Olio

For those of you who are not crossword puzzle addicts, olio means a collection of something. Yes, I admit to being a crossword puzzle addict. It's the first thing I reach for when I get on a plane. Most of the airline magazines have one toward the back. And I subscribe to *New York* magazine for their puzzles.

Our Unconstitutional Congress

A recent piece by Stephen Moore of Cato Institute in *Imprimis*, which you probably missed, discussed the breaking of the Constitution by Congress, with the connivance of the Supremes.

In 1800, when the capital was moved from Philadelphia to Washington, all of the government's paperwork was packed into twelve boxes and moved by horse and buggy. At that time our government had less than 3,000 people and a budget of under $1 million. That's about $100 million in today's dollarettes. Now we have over 18 million employed and a budget of $1,600,000 million.

What happened?

The US Constitution was established as a set of rules for our government, with its responsibilities restricted to its enumerated powers, which mainly involved national security and public safety. You will not find any authorization in the Constitution for at least 90% of the civilian programs that Congress has in the federal budget.

The founders, well aware of the propensity of governments to bloat, tried to prevent this by making the Constitution very specific on this matter. The Tenth Amendment says, "The powers not delegated to the United States by the Constitution … are reserved to the States respectively, or to the people." There was nothing in there about subsidizing the poor, the power companies, farmers, maple syrup production and advertising commercial names in Europe and Japan.

For over a hundred years presidents vetoed every effort by Congress to spend money on public charities, citing the Constitution. Then two things happened (went wrong!). The first was the 16th Amendment, the enactment of the Federal Income Tax in 1913. This cash cow was just too much for Congress to resist. This brought about the perversion of Article 1, Section 8 of the Constitution, which says, "The Congress shall have the power to lay and collect taxes, duties, imposts, and excises to pay the debts, provide for the common defense, and promote the general welfare of the United States."

Jefferson explained that "the general welfare" clause had only to do with those powers specifically enumerated by the Constitution.

The flood gates really opened with Roosevelt's New Deal. The pork barrel was finally wide open, with the Supreme Court in 1936 providing the coup de grâce by ruling that the Agricultural Adjustment Act was constitutional. The New Deal Court essentially told Congress that it didn't matter what the Constitution said, spend whatever you please. And they sure have!

Just before World War I the total federal expenses ran about 2% of the GDP and the top income tax was 7%. But it was during World War II when it really hit the fan, with the introduction of rent control and withholding taxes. The government took our tax money before we even had a chance to see or feel it, and wow, has Congress had fun at our expense! They take away dollars and give back a few pennies, and we gratefully re-elect our benefactors. Why does this remind me of the bull ring, with the matador waving a red flag at the bull to keep his attention while he maneuvers him anywhere he wants to?

Can we ever get back to using the Constitution as a set of rules for running our country as the founders intended? Lordy, that would put maybe 15 million government employees out of work! It might even get the government out of screwing up our school, health, legal, prison, and other failed systems.

An AIDS Vaccine

President Clinton has called for the drug companies to get an AIDS vaccine to market within 10 years. The government is already spending $150 million annually on an AIDS vaccine research, so there is a huge vested interest in not making any waves.

I see two minor problems. First, there is no evidence that most vaccines actually solve problems. This appears to be another big medical scam, which you'll understand when you read a couple of the very well researched books I've recommended in my editorials. Second, drug companies, with the cooperation of the FDA, make sure that only patentable drugs are authorized for the treatment of illnesses. Thus any inexpensive, non-patentable treatment will be not just ignored, but will be fought vigorously by both the medical establishment and the FDA.

Third (a bonus), AIDS now seems to be more of a lifestyle problem than a specific

disease, one which can be reversed by stopping the destructive lifestyle. This means one has to stop poisoning one's body and give it the nutrients it has been designed to need. Thus there is no hint that there can ever be a vaccine developed for AIDS.

In the meanwhile there are all sorts of potential problems for public mischief. In a panic we rushed polio vaccines into our kids in the 1950s. Well, it now appears that, gee, there was some contamination with Simian Virus 40 which is strongly suspected to be causing brain, bone and lung cancers in adults and children.

My thanks to Frank Kavenik WA9QJR for sending me this item.

More Medical Mischief

You probably don't read *Penthouse*, and you probably also missed the publisher's interview with Art Bell, where he went into detail about his wife's brush with death by cancer. The story is in the September issue, and it's a horror story about the National Cancer Institute, the FDA, the AMA, two leading cancer-specializing hospitals, and his success using hydrazine sulfate, despite every effort of the hospitals and government to prevent its use.

The fact is that radiation and chemotherapy not only don't work, they often are more the cause of death than the cancer they are supposed to fight—at humongous expense. Hydrazine sulfate costs about $150 a year, and is unpatentable.

You can get the full facts on this if you missed getting the magazine by writing to *Penthouse*, 277 Park Avenue, NYC, and put "Cancer" on the envelope.

Budget Baloney

Not to worry you about something over which you have little (read: no) control, but I'd just like to note that unless the world does come to an end in 1998, 2000, 2005, or 2012, as threatened by some doomsayers, the Democrats and the Republicans will have again sold us down the river with the recent so-called balanced-budget agreement. Some balance.

Our party leaders took advantage of our unusually bullish economy to distribute a bunch of very questionable handouts to make themselves look good. The suckers are the future taxpayers who will have to deal with the mess.

Where did the money come from? Well, the Congressional Budget Office a year ago forecast a budget deficit of $170 billion. Now it looks as if it's going to only be $40 billion, giving the Democrats and Republicans $100 billion or so to play with. Whoopie, let's have a party! The President asked for $16 billion to fund health care for poor children and they gave him $24 billion. Then came a raft of special interest tax breaks. Like around $150 for middle-income families, $15,000 for the richest one percent of families, and more like $2 million for the likes of Michael Eisner. Figures. I'm chuckling because it was the tax increases on the wealthy in 1990 and 1993 which made this possible.

Experts agree that in about three years the deficit will not just reappear, but will skyrocket as the baby boomers start reaching retirement age. This will reduce the number of taxpayers and escalate spending on Social Security, Medicare, and Medicaid.

A Head of My Time

Hy Chantz W2HY was kind enough to send a clipping of a new product by Rossignol, the ski company, which is one I've suggested in my editorials. They've announced in-line skates which snap onto what looks like high end sneakers. Well, I've been thinking of learning to use roller blades anyway, so this will probably push me over the edge. Their Traffic skates are $150, which isn't much more than a good pair of well-advertised sneakers these days. Let's see, where did I put those knee and elbow pads, and head protector?

Not that I'll have a lot of opportunity to use 'em, since I live on a dirt road which turns to mud in the spring, a dust-clouded corduroy in the summer, and an Olympic-quality sled course in the winter.

Another Excuse

The *Journal of the American Medical Association* published a report saying that boys born to mothers who smoke during pregnancy have been found to be much more likely to exhibit aggressive, destructive or

other problem behaviors. Nicotine, they explain, tends to disrupt fetal brain development—an invisible birth defect.

Maybe that helps explain the bad language and intentional QRM on our bands.

It also raises the question, since researchers have been able to tie certain brain changes to prenatal nicotine in the mother's blood, as to what other changes it may cause—physical and genetic changes which are irreparable.

They've found similar influences from the prenatal use of alcohol, crack, and other drugs, with thalidomide being an outstanding example, so I'll be really surprised if many drugs used by mothers during pregnancy don't also do permanent damage to children. Like caffeine, aspirin, sleeping pills, and just about any other medication. Of course, if you really don't care how your kid turns out, then what's to worry? This could help to explain the growing percentage of children being born with obvious birth defects.

Space Radiation

A letter from a *73* reader who'd read René's NASA book had just one question. How come, if the effects of radiation in space are so lethal, the Russians aboard *Mir* have managed to survive? Hey, that's easy. *Mir* and all of our recent space exploration has been well below the Van Allen Belt, which shields them and Earth from the sun's killer radiation.

Speaking (well, writing) of *Mir* and the planned American space lab, has anyone been asking what the justification is for spending so many billions of dollars? *Mir* has been up there for years and what scientific benefits have the Russians reaped as a result? What scientific breakthroughs have been achieved from our own space experiments? Enlighten me, please. Other than as scientist and engineer welfare, what's the benefit to all of us in spending all that money?

Worse, by providing highly-paid jobs working for NASA and their contractors, our beloved government is keeping thousands of scientists from being available for private industry, where the long-range benefits would, I expect, be far greater for our country.

Japan, which has *not* spent billions on military and space projects has used its technical manpower to bury us with innovative high-tech products. Scientists and engineers in Japan go to work for Sony, Hitachi, Toshiba and so on. Ours are almost all sucked into NASA and military R&D.

The Bright Side

As shortwave broadcast stations move to the Web, we'll see 40 m opening up again for us. And we'll see not just less pressure from other services for our HF bands, we'll eventually be in a position to ask to have our bands expanded. We may go back to 7.0-8.0 MHz for 40 m, and 14.0 to 14.4 for 20 m. Or even up to 15 MHz, since commercial and government use of the HF bands will have long been moved to satellite relaying systems, which have wider bandwidths and 100% reliability.

One thing will be for sure, the CW-forever guys will be pounding away at 15-20 wpm while the rest of the world is sending audio and video anywhere in the world. Heck, I'm seeing data rates of 2,048 Kbps already in use. And we think 9.6 Kbps is fast!

Being a geriatric case, I can remember way back when amateurs pioneered new modes and higher-speed communications. Now, with the vigorous support of the ARRL, we're fighting hard to maintain the oldest and slowest radio communications system ever devised.

Yes, I agree, CW is fun. And so is making Daguerreotype photos. And running Stanley Steamers or Model Ts.

Industry Blindness

Recent brochures from power company conferences contain no hint of the coming cold fusion revolution. Well, I saw the same thing happen to the computer mainframe companies when the minicomputers came along. And then again when microcomputers (personal computers) arrived. The major computer conferences put personal computers down in the basement, or in an outbuilding somewhere. But that was only after a hard battle to even get a foot in the door.

The biggest computer conference of all, the National Computer Conference (NCC), got blown away for just this reason.

Even a 1998 conference on Renewable Energy Technologies is covering only solar, biomass, photovoltaic, small hydro, and wind power technologies—few of which are going to even be *around* in 20 years.

Elemental Energy

I've changed the name of my *Cold Fusion* journal to *Elemental Energy* for two reasons. First, it better expresses the physics of this new energy source, and second, cold fusion has had such a bad rap from the establishment that it's easier to change the name than fight emotional prejudice. The excess heat being generated by the cold fusion process is the result of the transmutation of elements. You see, when some elements are transmuted into others, there is a very tiny bit of mass lost in the transfer. But by the time you multiply this times Einstein's c^2 you have a serious bunch of energy generated as heat. That's the speed of light, squared.

Faster! Faster!

We could speed up data transmission by about three times if we encoded our words differently. Right now our computers encode every letter of every word, plus the space between words. With an average word length of five letters, plus the space, that's six characters we send for each word.

Our bytes have eight bits, providing us with 256 possible characters in the ASCII code. Plus a start, a stop, and a parity bit. That's 11 bits total for each byte.

But what if we were to assign a number for each word in the English language?

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 E Chateau
Payson AZ 85541
[jimpeg@netzone.com]

The best (G) days for radio propagation are likely to be the 3rd–5th and 14th, while the worst (P or VP) are likely to occur from the 17th–20th and again on the 23rd or 24th. The remaining days are either Fair (F) or trending as shown on the calendar.

Remain alert during the 17th–20th for other geophysical effects on Earth, including earthquakes, volcanism, and unusual weather conditions. An early winter is possible in the northern US, beginning mid-month.

As this is written (mid-August) solar flux unexpectedly remains in the 70s, having shown few signs of increase for nearly two years ... resulting in stagnant DX conditions with few golden opportunities.

10–12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15–17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the US.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30–40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), and also short-skip during hours of darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet. W1XU. 73

NOVEMBER 1997

SUN	MON	TUE	WED	THU	FRI	SAT
						1 F
2 F-G	3 G	4 G	5 G	6 G-F	7 F	8 F-P
9 P-F	10 F	11 F-G	12 G-F	13 F-G	14 G	15 G-F
16 F-P	17 P	18 P-VP	19 VP	20 VP-P	21 P-F	22 F-G
23 G-F	24 F-P	25 P	26 P-F	27 F	28 F-G	29 G-F
30 F						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20					20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

Using 17 bits we'd be able to define 131,072 words, plus the start, stop and parity bits would give us 20 bit superbytes. That would enable us to send a word with 20 bits instead of 66 bits, a 3.3 times improvement in throughput.

This would have the added value of making the translation to any other language automatic. Backwards, of course, some sentences would be. But we can live with that.

Our computers would have no problem in handling shorter bytes for numbers, punctuation, and special characters. If the byte comes through with 20 bits it's a word. If it's 10 bits it's not.

Just because we're still stuck with the hundred-year-old typewriter key arrangement doesn't mean we have to keep living with the old ASCII character set forever. In case you've forgotten, the keys were arranged to slow down typing so the typewriter wouldn't jam with a fast typist. 73

Number 88 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)— comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the February 1998 classified ad section is December 12th, 1997.

HAM GOODIES! Free Shack Attack Catalog. (801) 878-2760, [kb7vrd@aol.com], [http://www.vcnet.com/sa]. BNB45

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The Kachina 505DSP Computer Controlled HF Transceiver After twenty years of building commercial transceivers in Arizona, Kachina has decided the time is right for a new approach to amateur radio. The Kachina 505DSP is nothing short of a revolution in HF transceivers.

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6 IF BANDWIDTH FLEXIBILITY • Standard 2.4 kHz filter can be narrowed continuously to 800 Hz with variable Bandwidth Control (BWC). Narrow SSB and CW filters for 2nd and 3rd IF optional.

7 QRM SUPPRESSION • Other interference rejection features include Passband Shift (PBS), dual noise blanker, 3-step RF attenuation, IF notch filter, selectable AGC and all-mode squelch.

8 NOTCH TRACKING • Once tuned, the IF notch filter will track the offending heterodyne (±10 Khz) if the VFO frequency is changed.

9 DDS PHASE LOCK LOOP SYSTEM • A single-crystal Direct Digital Synthesis system is utilized for very low phase noise.

10 CW FEATURES • Full break-in operation, variable CW pitch. built in electronic keyer up to 60 wpm.

11 DUAL VFOs • Two separate VFOs for split-frequency operation. Memory registers store most recent VFO frequency, mode, bandwidth and other important parameters for each band.

12 200 MEMORIES • Memory capacity of 200 channels, each of which store frequency, mode, AGC and bandwidth.

13 COMPUTER INTERFACE • Built-in RS-232C interface for advanced computer applications.

14 ERGONOMIC LAYOUT • Front panel features easy to read color LCD display and thoughtful placement of controls for ease of operation.

15 HEAVY-DUTY POWER SUPPLY • Built-in switching power supply with "silent" cooling system designed for continuous transmission at maximim output.

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CIRCLE 159 ON READER SERVICE CARD